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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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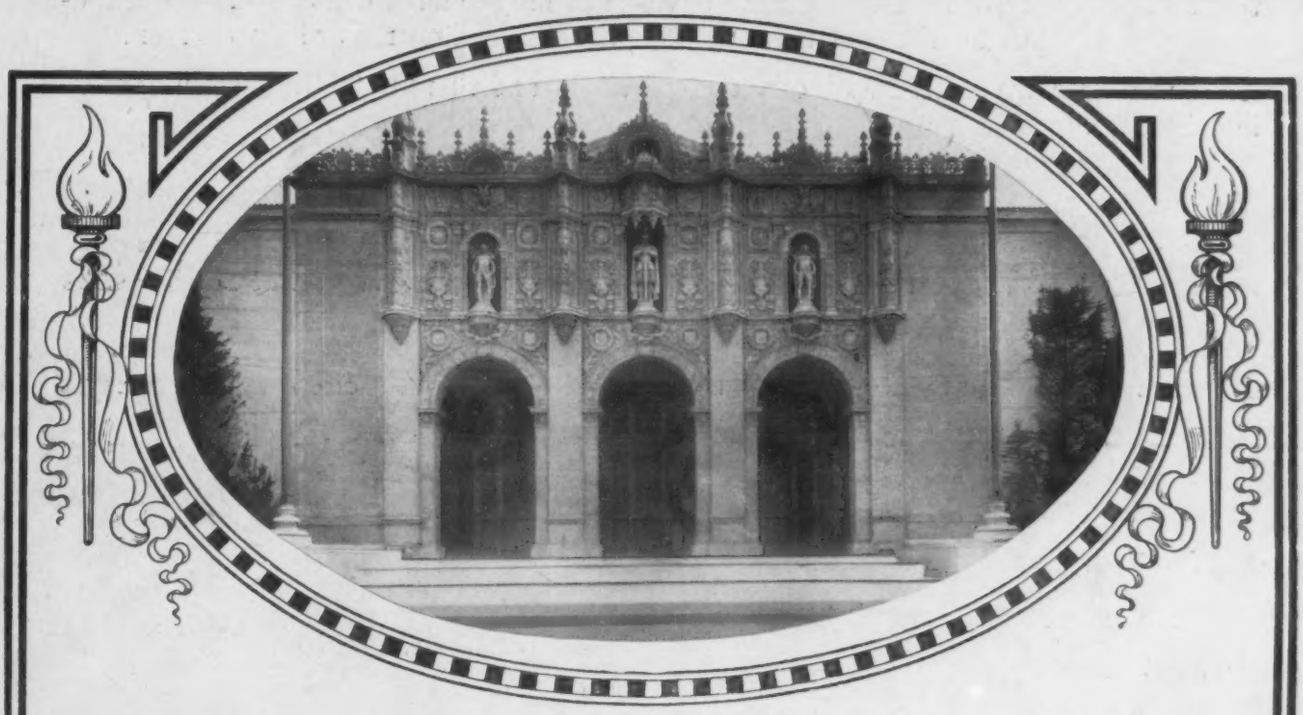

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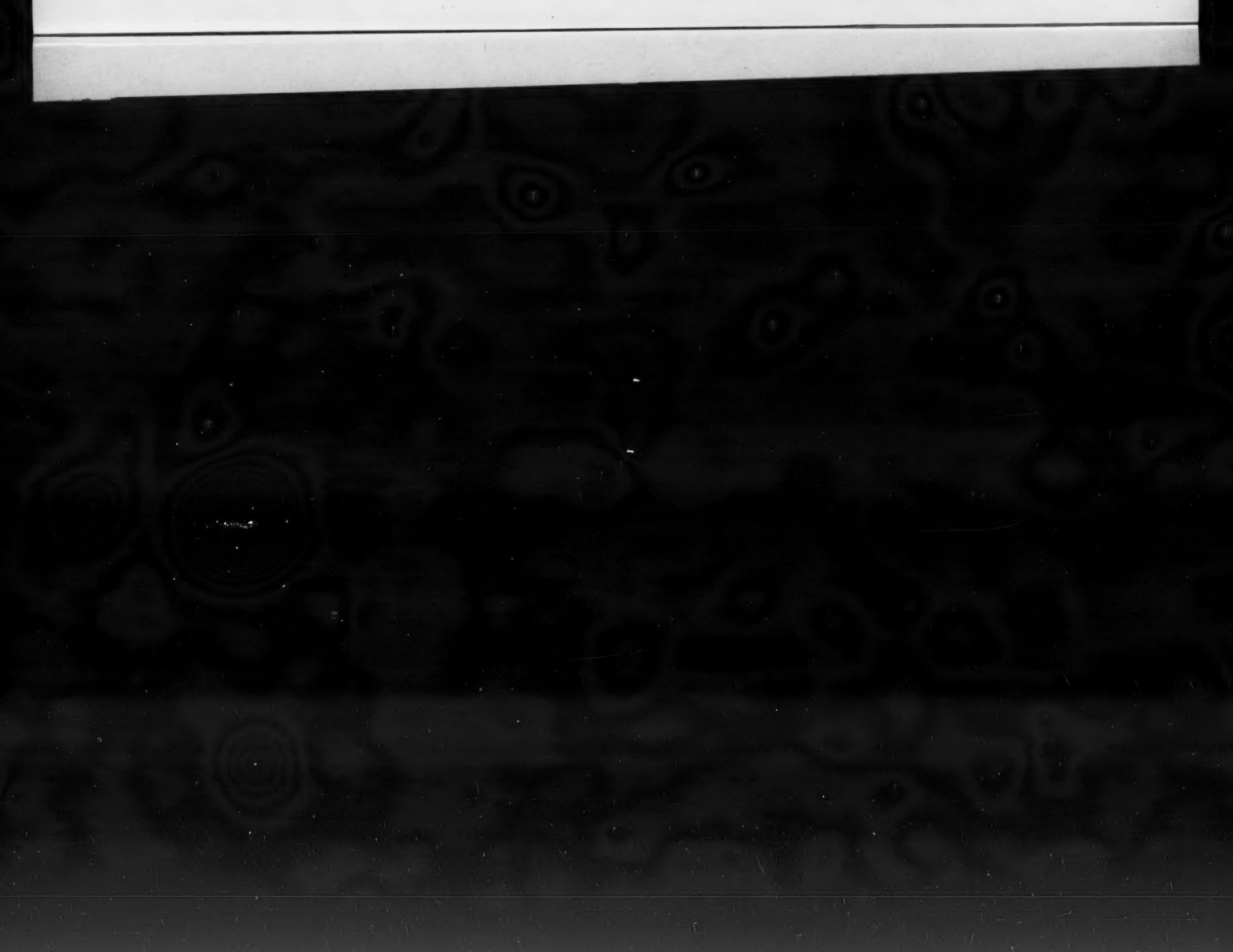

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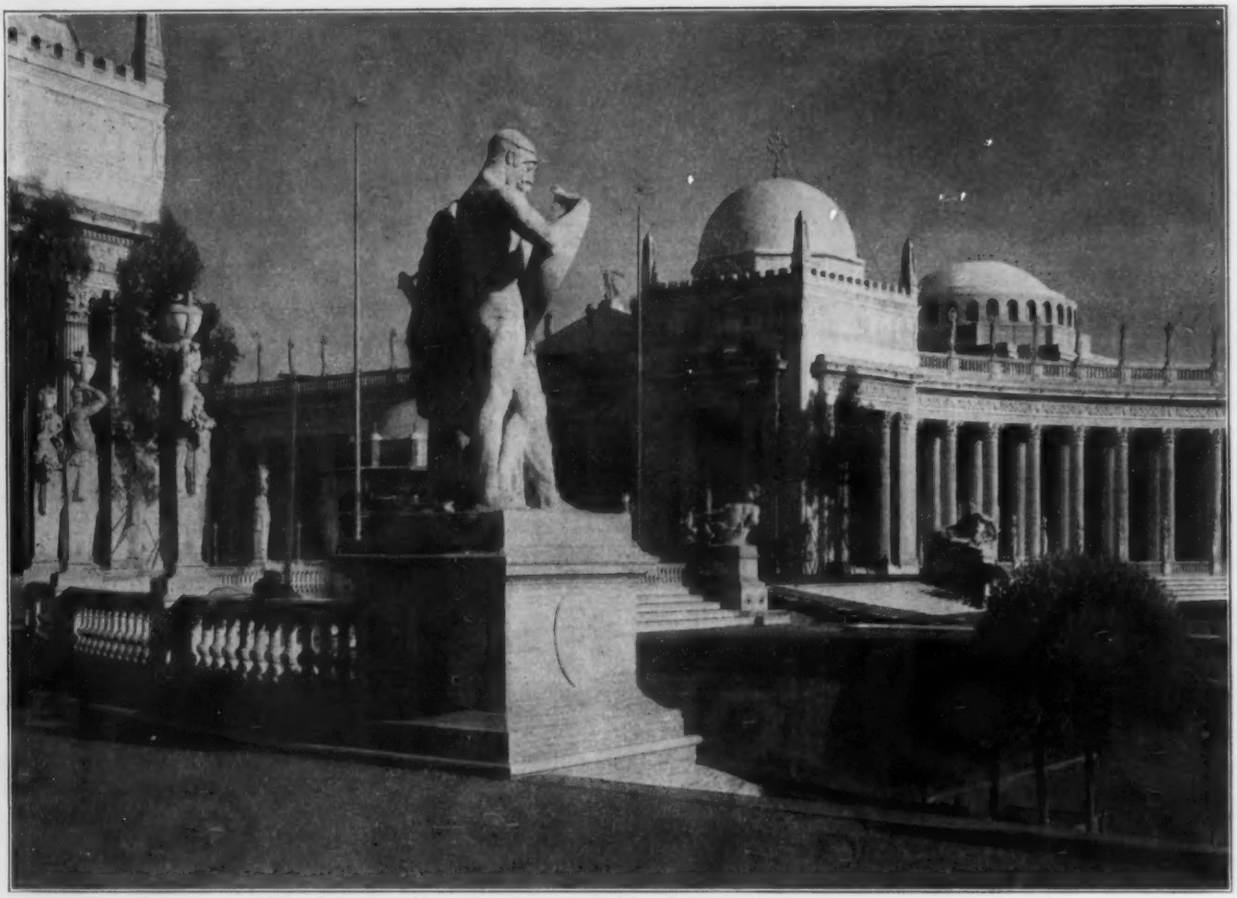
ELECTRICITY IN THE TRANSPORTATION PALACE

Electricity is now so intimately identified with transportation that any modern display of transportation methods is expected to show much electrical equipment. This expectation is fully met in the Transportation Palace at the Panama-Pacific International Exposition. In general and in accordance with the educational purpose of the entire exposition, these exhibits are intended to instruct the visitor in the present stage of the art. But in addition to its general educational value the Transportation Palace contains many exhibits of direct and deep interest to every electric railway man. All of these have been brought together through the indefatigable efforts of Blythe H. Henderson, chief of transportation.

Besides the display of the latest developments in electric railway apparatus and supplies there is also a large supplementary exhibit of electric vehicles and trucks for which space had to be provided in an auxiliary building. These, together with a complete account of the manifold applications of electricity to the gasoline automobile, will be described in a subsequent article.



P. P. I. E. Transportation Palace.

Closely allied to the display of electric locomotives, cars, motors and control apparatus, are the exemplification of the "safety first" movement and the moving picture exemplifications of what constitutes service. Operating and shop details are also well portrayed.

Considerable interest also attaches to the steam locomotive and steamship exhibits which are likewise to be found in this great palace. But the present article will be confined exclusively to the electric railway and allied exhibits.

Westinghouse Electric & Manufacturing Co.

The central feature of the Transportation Palace is the 4000 h.p. Pennsylvania locomotive exhibited by the Westinghouse Electric & Manufacturing Company. This, together with its great revolving turntable, was illustrated and described in detail in this journal under date of March 20, 1915. Surrounding this central locomotive the Westinghouse company has grouped an attractive display of much of the equipment that goes to make possible modern transit efficiency.

Control apparatus is exemplified by exhibits of their type "H L" and "P K" control. The latest form of H L control is mounted on a rack and connected to a pair of motors in such a way that the operation and construction may be easily observed. There are eight electro-pneumatically operated unit switches mounted in a frame, on the end plates of which are carried the overload trip relay, motor cut-out switches and reverser. Each switch is provided with a powerful magnetic blowout, and is held open by a strong spring. The switches are closed when desired by compressed air acting on a piston, which forces the switch jaws together against the spring pressure. Air is admitted to or released from the cylinders by small magnet valves, operated by power obtained from a shunt circuit from a control resistance connected between trolley and ground. This control circuit is carried through the master controllers and to train line receptacles at the ends of the car, so that the switches on a number of cars can be operated simultaneously from any master controller. The direction of motion of the car or train is governed by a pneumatically operated drum type reverser, mounted on one of the end plates of the switch group. The drum is moved to the forward or reverse position by two pistons similar to those used with the unit switches.

The Westinghouse P K equipment offers many of the advantages of H L control, while retaining the K controller, resistance, wiring, etc., with which many roads are already equipped. Two control racks are shown connected up to represent a two car train, and arranged for actual operation. The essential feature of the equipment is the type "P K" pneumatically operated head. With the aid of compressed air from the brake system, this head is utilized to operate the main and reverse drums of the controller on the car under the direction of a master controller on each platform. The motorman, by operating the master controller, effects a corresponding movement of the main controller drum or commutating switch through the medium of the "P K" head. If two or more cars are coupled together in a train, the "P K" heads on each of the cars will operate simultaneously under the direction of the master controller on either platform of any car.

Railway motors of various types and ratings, including both box and split type motors, are shown. This portion of the exhibit comprises a standard 55 h.p., 600 v., box type, field control motor, weighing 2630 lb.—for city or light suburban service; a standard 140 h.p., 600-1200 v., box type motor, for heavy high speed, interurban service, weight 4250 lb.; a 40 h.p., 600 v., split frame motor for city service—weighing 1990 lb.; a 67 h.p. at 600 v.—and weighing 2700 lb.; a 48 h.p. at 600 v., box and split type respectively, weighing 2325 and 2375 lb—for city service; and the original "baby" motor for 24 in. wheels on low floor cars, rating 37 h.p. at 600 volts, and weighing 1680 lb. complete.

There is also shown a sample of the new pressed steel railway motor—the latest stride in the development of railway equipment by the Westinghouse Company. The 225 h.p., single-phase motor used by the Pennsylvania Railroad on the Philadelphia Paoli electrification, is exhibited, as well as an experimental double armature motor for use in 5000 v. direct current service.

The overhead trolley line material display is so arranged as to afford ready inspection and comparison of the various types of trolley cars, complete suspensions, frogs, splicers, clamps, strain insulators, strain plates, section insulators, crossing, etc. Prominent in this list are the following: type "GF" 2 piece catenary hanger, "PG" porcelain strain insulator, "EL" clinch ear, Detroit frog, Cleveland splicer, and "RE" mine clamp.

Railway lightning arresters are demonstrated in an interesting manner with the aid of a 5 kw. step-up transformer supplying 13,000 volts to a set of condensers and two adjustable spark gaps. By means of this apparatus high voltage discharges are created and then dissipated by the arresters. The well known type "MP" 1000 volt, and the condenser type "K" 600 volt arresters are thus demonstrated in a manner approaching actual service conditions. The type "MP" arrester is designed for car, line or station use on alternating or direct current. The type "K" or condenser type arrester is used for car or line protection on direct current circuits.

Type "A" electolytic and low equivalent arresters are also displayed.

The exhibit of insulating and repair materials for railway apparatus offers an excellent opportunity for those interested to learn what materials are used in building up and repairing railway motors and control. Micarta, a Westinghouse innovation is primarily an insulating material, but its uses are many, especially since it is susceptible to being machined. It has found great favor in high frequency and high voltage work. High dielectric and mechanical strength and its heat resisting powers are common properties of micarta. A rack of micarta samples displays this material in various shapes and sides.

Exhibits of Westinghouse Electric & Manufacturing Company in Transportation Palace.

Other insulating and repair materials exhibited are treated cloths and papers, untreated cloths and papers, mica wrapper, insulating and soldering compounds, and A-R-C cement.

The portable substation is shown in model form The model is complete in every respect, and clearly illustrates each integral part.

Portable indicating meters and instruments for both alternating and direct current are shown as well as the Westinghouse watthour meter and a more recent product in the form of a maximum demand indicating meter, known as the type "RO" meter, which combines all the features of the standard Westinghouse integrating watthour meter with the necessary parts to indicate the maximum demand on any system in which the meter may be connected.

Various types of standard meters are shown, including rotating standards, precision instruments and laboratory standards. A complete test table is so arranged to allow of running accurate tests and demonstrations on the various types of meters exhibited. Watthour meters may be checked against rotating standards, and rotating standards may be checked against precision and laboratory instruments.

Control apparatus is shown in the "sunset" corner of the exhibit. This includes a 10,000 ampere, 750 volt, carbon circuit breaker mounted on a 3 inch panel, and arranged for electrical operation; a complete switchboard for the control of alternating current generating apparatus with exciter panel, generator panel and feeder panel; and one pole of a 300 ampere, 165,000 volt oil circuit breaker. The 165,000 volt oil circuit breaker is the most gigantic breaker ever built, and shows all the characteristics of the standard line of Westinghouse high power, high voltage GA oil circuit breakers, which are practically uniform in their construction from 11,000-165,000 volts up to 600 amperes. A 35,000 volt oil breaker of the same type mounted beside the 165,000 volt breaker may serve as an example.

A selection of graphic recording and 9 in. indicating meters as well as oil circuit breakers for switchboard and structural mounting, together with an 88,000 volt condenser type transformer terminal complete the exhibit in this corner.

Automobile equipment, consisting of both electrical equipments for gasoline cars, and motors and control for electrical vehicles, all supplemented by a complete demonstration of battery charging devices, such as motor generator sets, mercury arc rectifiers, switchboards and instruments, are to be found in the northeast corner of this space.

Those visitors who are engaged in the motor car industry, as well as car owners, have appeared greatly interested in the working exhibits of a Pierce Arrow engine and a Buda engine upon which are mounted the Westinghouse starting, lighting and ignition equipments. This system, the 6 volt, single wire (ground return), was originated and developed by the Westinghouse Company.

A full line of ignition and lighting generators for either 4 or 6 cylinder cars, together with starting motors, switches, meters, lamps and wiring devices, are shown.

Of electrical vehicle equipments, several types of motors are shown, one having a section cut away to show the interior construction and quality of materials used in the manufacture of vehicle motors for electric cars or trucks. In addition, there are the controllers and switches for use with vehicle motors.

For the garage owner or automobile dealer an interesting display of battery charging appliances is made. A motor generator set with auto starter and switchboard for charging five cars is in daily operation.

There is also a Westinghouse Cooper-Hewitt mercury arc rectifier which is exceptionally well adapted for private garage use in the charging of all batteries of electric vehicles. The method of charging the small 3 cell, 6 volt battery as used on gasoline cars for lighting is shown through a display of a vibrating rectifier. A Westinghouse electric tire vulcanizer is given due prominence also.

Southern Pacific Company's Exhibit.

Of particular electrical interest is the all-steel motor car, 800 of which are used by the Southern Pacific Company in its Alameda County, Cal., service. The car is 72 ft. 4½ in. long, seating 116 people by a unique seat arrangement, whereby three persons sit on one side of the car and two on the other, the aisle being off center. These cars were designed by A. H. Babcock, electrical engineer for the company, and are equipped with General Electric motors and "deadman" control, the motorman's hand necessarily being on the control lever whenever the train or car is in motion.

The center-entrance type of car operated over the lines between Oakland and Alameda is also on display. Each entrance has three doors, the central for entrance and the others for exit purposes. This is likewise an all-steel car and is equipped with Westinghouse motors and P K control.

A comprehensive exhibit of steam equipment occupies a large portion of the Southern Pacific Company's space. This ranges in size from the 39,000 lb. "C. P. Huntington," the first locomotive of the Central Pacific, to the 625,000 lb. latest type of Mallet consolidated engine. It operates with the cab end ahead, this arrangement being made possible by use of oil for fuel, thus giving the engineman unobstructed view of track at all times. It is equipped with standard incandescent headlight, using latest type Mazda lamps of 140 candlepower, which, with reflector, gives beam sufficient for the engineer to see a man on track at distance of one-quarter mile, or about twice the distance required to stop a train running at forty miles an hour.

Two Southern Pacific standard automatic electric block safety signals, one of which, equipped with glass case, is in operation, are also on exhibition.

An eight-wheel, 137,400 lb. locomotive has been cut away so as to expose the interior workings, the driving wheels being placed on rollers and operated by electric power, moving the valves and piston as in actual operation. A number of passenger coaches, stock cars, fruit express car and postal car complete this exhibit.

The General Electric Company's Transportation Exhibit.

Among the varied railway exhibits in the palace, that of the General Electric Company is attracting much attention. This exhibit not only shows a full assortment of electric locomotives, but, in addition, the essential parts of all electric traction and points of its operation. Locomotives stand on a track at one side of the exhibit and mounted on platforms are street car motors and control, car equipments, signal devices and railway shop equipment, connected up for actual demonstration.

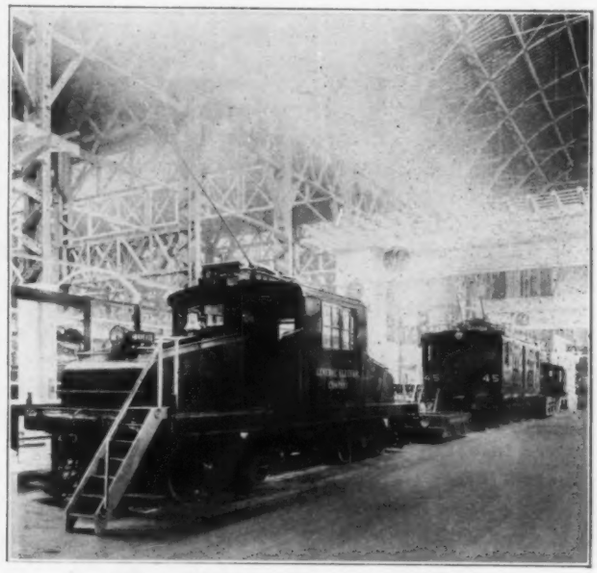
General Electric 2400-Volt Passenger Locomotive.

Five types of locomotives are shown ranging from the heavy 2400 volt passenger locomotive to the diminutive mine hauler for underground use. The largest of the group is a duplicate of twenty-one built for the Butte, Anaconda & Pacific Railroad for transporting passengers and ore between Butte and Anaconda, the first 2400 volt direct current locomotives ever built. The locomotive weighs 80 tons complete, but for operation two are coupled together as the hauling unit. Speeds up to 21 miles per hour with 4600 ton freight trains and 45 miles per hour with standard passenger trains are obtained by these locomotives.

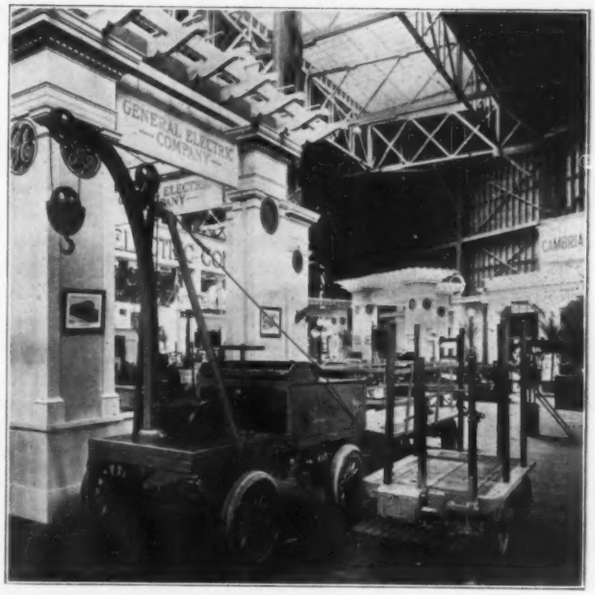
The locomotive next in size is an all-steel 60-ton locomotive, standard for interurban freight and passenger and heavy switching service, and designed for both 600 and 1200 volt direct current operation. It is equipped with type "M" multiple unit control and combined straight and automatic air brakes for train operation, and is driven by four commutating pole motors of forced ventilation type.

The remaining three locomotives are a 16-ton light freight and switching service unit, and two types of mine haulers. One of these is a 20-ton three-motor trolley type locomotive for heavy mine duty, and the other a 6-ton combination trolley and storage-battery locomotive for remote shaft work, where it is often not feasible to string trolley through the full length of the shaft.

Exact operating arrangement, connection and control of street car motors are clearly shown by the rack-mounted equipment. Standard motors on standard trucks have been mounted under racks, wired with their standard control apparatus, and connected for actual operation. The whole arrangement represents the complete underframing of a two-car train with all accessories, and allows the operation to be easily demonstrated either as single cars or a 2-car train on multiple unit control. Illuminated diagrams connected with the control system indicate by lighted lines the connections of the motor circuit at each step on the controller.



Group of General Electric Locomotives.



General Vehicle Company's Electric Truck.

On another rack is shown a complete type "M" multiple unit control, designed for "three-speed" operation, a recently developed system for city service. The motor circuit connections at each step of this system are also shown by means of another illuminated diagram similarly mounted on a frame.

All sizes of ventilated commutating-pole motors are shown complete, and one, a 60 h.p., 600 volt, 245 type, is shown exploded, with partially wound armature and partially insulated field coils to illustrate the methods of construction.

Complete air compressor outfits have been mounted on stands showing all details of air brake equipments. A storage battery platform truck and the battery crane truck, which did such efficient work during the construction of the Exposition, stand near. One of the air compressors is fitted with a glass cover and its interior illuminated, to show its actual operation.

A number of separate valves, governors, rheostats, switches, lightning arresters, and other devices entering into complete car equipments are exhibited. A complete set of gears, split and solid, forged and cast steel, and pressed steel gear cases for urban and interurban service are shown, together with several forged steel treated pinions and a pinion puller. A display of railway Mazda lamps effectively demonstrate modern systems of car lighting, and automobile lamps and accessories, including the new Ford starter, are also shown. There is also a complete line of incandescent and luminous arc headlights with semaphore lenses and parabolic reflectors as are used on urban, interurban and suburban cars.

One interesting part of the exhibit is given over to specialties and semi-specialties and standard appliances for particular uses. These include a new high frequency oscillator for insulator testing, an electric arc-welding outfit, a new switchboard multi-recorder for automatically recording the time of manipulation of various switches, and a complete line of railway circuit breakers. There are also various types of battery charging rectifiers and signal accessories in switchboad instruments, vacuum and multigap lightning arresters, transformers and a motor generator set.

An attractive and instructive feature of the exhibit is a "Stereomotograph," projecting illustrations automatically on a large translucent screen. These illustrations, of which there are several hundred, cover subjects of modern traction developments, and were made from actual photographs. These photographs were taken in all parts of the country and show important applications of recent railway equipment of all kinds, and many typical power-plant and substastation installations. The display as a whole is an illustration of what has been done in the different sections of our United States in the way of traction development in the past few years.

Edison Storage Battery Supply Company.

The Edison Storage Battery Supply Company has a comprehensive exhibit occupying 1500 sq. ft. in the automobile section of the palace. All types of Edison storage batteries are shown, together with large exhibit boards showing various parts of the battery in the process of manufacture.

There is a complete marine exhibit, including marble switchboard, a 14 in. searchlight dynamo and gas engine and various fixtures used particularly in marine service.

Three automatic signals are in operation, two being operated with Edison primary batteries and the third with Edison storage batteries, the operation of the signals being timed by a motor-operated contact device, so that one of the signals is always in motion.

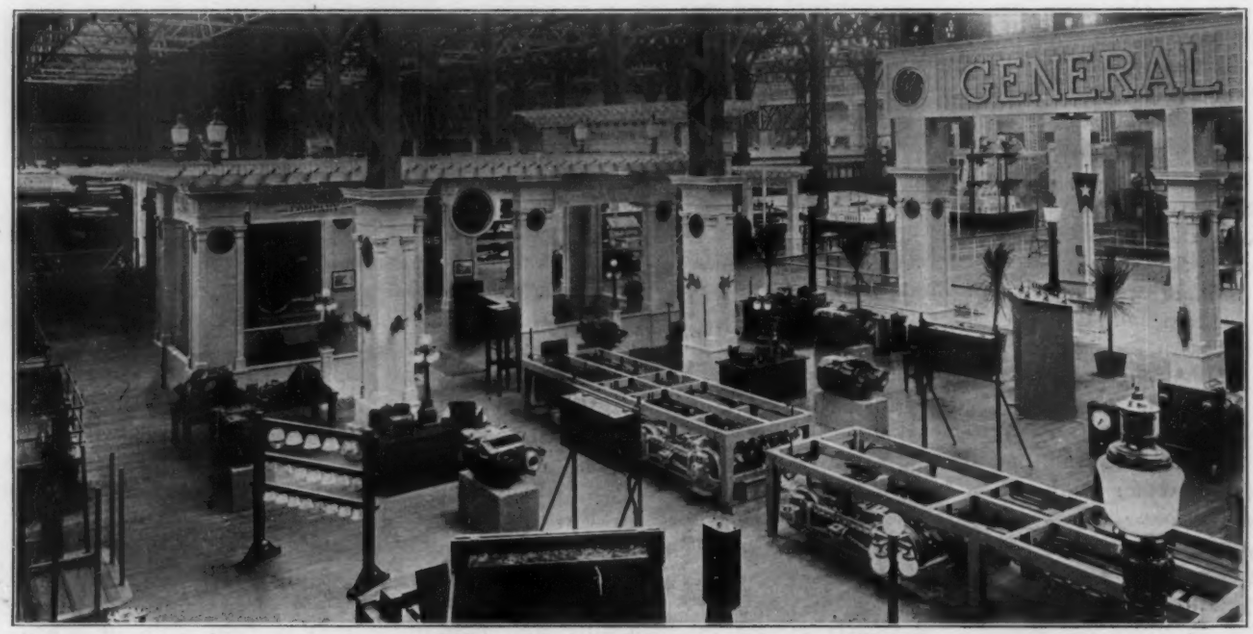
The complete equipment for steam railway car lighting is shown in detail.

There is also a complete house or farm lighting plant in operation with gas engine, dynamo, switchboard and storage batteries with certain ornamental lighting fixtures and features, designed for the purpose of showing how the poor down trodden farmer can add another detail of luxury to his bungalow.

The Edison Primary Battery Department occupies part of this booth, showing Edison primary batteries and their various applications, and Edison business phonographs or dictating machines.

Miscellaneous Exhibits.

The American Everready Company has a complete exhibit of electric and automobile specialties. The St. Louis Car Company shows two cars designed for street railway service. Several manufacturers of car wheels, track and fittings likewise have interesting displays.



General View of General Electric Company's Booth.

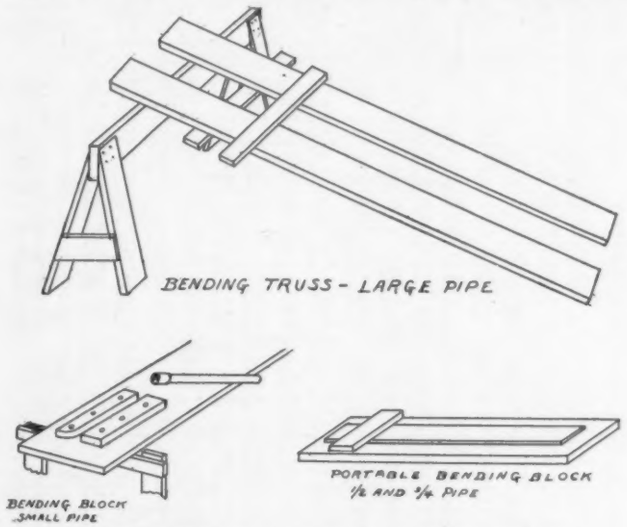
INSIDE WIRING METHODS

By JOHN CARRELL

Bending Conduit.

In the beginning, necessity caused a piece of one-inch pipe to be screwed into a plumber's tee that rigid conduit might be bent. The wireman called it a hickey and the name stuck. The modern hickey is a refinement of the original. The tee is made of a better grade of metal and the construction is altered somewhat to admit of an easily secured purchase on the conduit. Hickeys are used extensively in working nominal ½ and ¾ in. pipe, but rarely on larger sizes.

Bending machines and devices of divers types are placed on the market at divers times. These usually consist of a form, a lever and a wheel. The advantage of such devices is in the making of bends of small



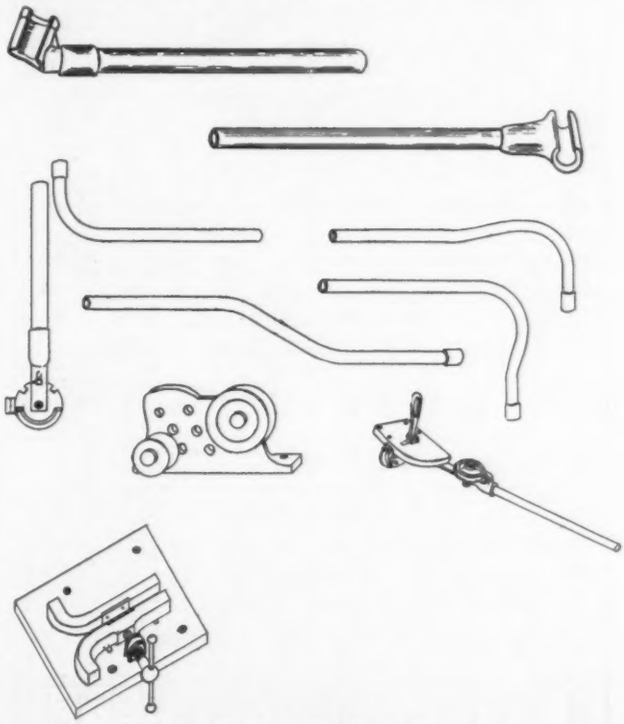
Easily Constructed Devices for Bending Conduit.

radius and uniform curve, or "square" bends, as workmen term them. But workmen bolt two timbers to the end of their bench, opposite the vise, placed parallel, forming a groove into which the conduit is placed. A section of larger pipe slipped over the conduit in the groove, forms the lever.

Bends in conduit of large size are expensive. Factory made elbows are used where practicable, but considerable bending must be done on the job. Where the construction of the building affords no easy method of securing the conduit to be bent, a truss is constructed. The most popular form of truss is made by placing two planks parallel and adjacent, with one set of ends on a wooden horse, and the other ends on the floor. Sticks are placed above and one below and each at right angles to the planks. If desired a third stick may be placed under the planks near the floor, to which a block and tackle or bending sling may be secured.

The art of bending conduit on the job has reached a fair degree of perfection, so much so that men, accustomed to the hydraulic benders and other highly developed machines found in modern shops, marvel at the speed and accuracy with which experienced electricians place conduit in buildings. The workman must not only know what is good to do, but must also have considerable practice in the doing; otherwise handy men had been good mechanics and electrical construction would be wished in place. To connect the given wiring points with the smallest amount of conduit, the lowest possible bends, and with minimum cutting and threading of conduit, the workman must have a careful training in the work, and have all of his tools and wits on the job in good condition.

Conduit bends may be classified as elbows, tangents, offsets and goose-necks, and combinations thereof. Of course an offset is simply two tangent bends made in opposite directions and a goose-neck is an elbow and offset combined.



Conduit Benders and Simple Bends.

To bend a 10 in. hook or elbow in ½ in. pipe, place a mark 10 in. from end of conduit, set the heel of hickey 4.5 in. ahead of mark and turn the end up. The radius of the conduit curve will be 4.5 in. or about 7.5 times the internal diameter of ½ in. pipe. This forms a good approximate rule for bending elbows with a hickey, or by means of a truss for any sized pipe, i.e. deduct the radius of the curve from the height of the elbow and start the bend at that distance from end of conduit.

To turn an elbow to run at right angles to a given line, place the heel of the hickey about 2½ in. ahead of the line for ½ in. pipe. This distance is the difference between one-fourth the circumference of a 9 in. diameter circle and the 4½ radius, or somewhat greater than one-half the radius.

Some workmen measure the conduit for an entire section of a building and do all their bending by means of a bending block at the vise. The measure-

CONSTANT → / SIZE OF WIRE	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	110	120	130	140	150	160	170	180	190	200	220	240	260	280	300
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4 41740	70	70	70	70	65	55	48	43	39	35	32	30	28	26	24	23	22	20	19	18	16	15	14	13	12	11	11	10	10	9	8	7	7	6
3 52630	80	80	80	80	80	70	61	54	49	44	41	38	35	32	30	29	27	26	24	22	20	19	17	16	15	14	14	13	12	11	10	9	9	8
2 66370	90	90	90	90	90	88	77	68	62	56	51	47	44	41	38	36	34	32	31	28	26	24	22	20	19	18	17	16	15	14	13	12	11	10
1 83690	100	100	100	100	100	100	97	86	78	71	65	60	55	52	49	46	43	41	39	35	32	30	28	26	24	23	22	20	19	18	16	15	14	13
0 105500	125	125	125	125	125	125	122	109	98	89	81	75	70	65	61	57	54	51	49	44	41	38	35	33	31	29	27	26	24	22	20	19	17	16
00 133100	150	150	150	150	150	150	150	137	123	112	103	96	88	82	77	72	68	65	62	56	51	47	44	41	38	36	34	32	31	28	26	24	22	20
000 167800	175	175	175	175	175	175	175	172	155	141	129	119	111	103	97	91	86	82	78	70	65	60	55	52	48	46	43	41	39	35	32	30	28	26
200000	200	200	200	200	200	200	200	200	185	168	154	143	132	123	116	109	103	97	93	84	77	71	66	62	58	55	51	48	46	42	39	36	33	31
0000 211600	225	225	225	225	225	225	225	217	195	178	163	150	140	130	122	115	108	103	98	89	81	75	70	65	61	57	54	51	49	44	41	38	35	33
250000	250	250	250	250	250	250	250	250	231	211	193	178	166	155	145	137	129	122	116	105	97	89	83	77	73	68	64	61	58	53	48	45	41	39
300000	275	275	275	275	275	275	275	275	275	253	232	214	199	185	174	163	155	146	139	126	116	107	99	93	87	82	77	73	70	63	58	53	50	46
350000	300	300	300	300	300	300	300	300	300	295	270	249	231	216	202	191	180	171	162	147	135	125	115	108	101	95	90	85	81	74	68	62	58	54
400000	325	325	325	325	325	325	325	325	325	325	308	285	265	247	232	218	205	195	185	168	154	142	132	123	116	109	103	98	93	84	77	71	66	62
450000	362	362	362	362	362	362	362	362	362	362	346	320	297	278	260	245	231	219	208	189	173	160	149	139	130	122	115	110	104	95	87	80	74	69
500000	400	400	400	400	400	400	400	400	400	400	386	356	331	308	289	272	257	244	232	210	193	177	165	154	145	136	128	122	116	105	96	89	83	77
550000	425	425	425	425	425	425	425	425	425	425	425	391	363	339	318	299	283	268	255	231	212	196	182	170	159	150	141	134	127	116	106	98	91	85
600000	450	450	450	450	450	450	450	450	450	450	450	428	397	371	347	327	309	292	278	252	231	213	198	185	174	165	154	146	139	126	116	107	99	93
650000	475	475	475	475	475	475	475	475	475	475	475	463	430	402	376	355	335	317	301	275	250	231	215	200	188	177	167	158	150	137	125	115	107	100
700000	500	500	500	500	500	500	500	500	500	500	500	498	463	432	405	381	360	341	324	294	270	249	231	216	202	190	180	170	162	147	135	124	115	108
750000	525	525	525	525	525	525	525	525	525	525	525	525	496	462	433	408	385	365	347	316	289	267	248	231	217	204	193	182	173	158	145	133	124	116
800000	550	550	550	550	550	550	550	550	550	550	550	550	528	493	462	435	411	389	370	336	308	284	264	247	231	217	206	194	185	168	154	142	132	123
850000	575	575	575	575	575	575	575	575	575	575	575	575	563	525	493	463	437	415	394	358	328	303	281	263	246	232	219	207	197	179	164	152	141	131
900000	600	600	600	600	600	600	600	600	600	600	600	600	595	554	520	489	462	438	416	378	346	320	297	277	260	245	231	219	208	189	173	160	148	139
950800	625	625	625	625	625	625	625	625	625	625	625	625	625	586	549	518	489	462	440	400	367	338	314	293	275	259	244	232	220	200	183	169	157	147
1000000	650	650	650	650	650	650	650	650	650	650	650	650	650	617	579	544	514	487	463	421	385	356	330	308	299	272	257	244	232	210	193	178	165	154
1250000	750	750	750	750	750	750	750	750	750	750	750	750	750	750	722	681	643	610	579	526	482	446	413	385	362	340	322	304	290	263	241	223	207	193
1500000	850	850	850	850	850	850	850	850	850	850	850	850	850	850	850	817	772	732	695	631	578	533	496	463	435	409	386	365	348	316	289	267	248	232
1750000	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	900	852	810	735	673	622	577	538	505	476	450	427	405	360	337	311	289	270
2000000	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1028	973	925	840	770	711	660	616	578	543	513	486	463	421	385	355	330	308

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Progressive Engineering School.

Carrying Capacities, in Amperes, of Rubber Insulated Wires and Cables.

Length one way ÷ loss in volts = constant. Vertically under constant find load in amperes. Horizontally from load in amperes find size of wire required. **Example:** Length, 300 ft. Loss, 3 volts. Load 208 amp. Constant = 100. Size of Wire = 450,000 c.m.

ments do not include deductions for bends. The amount to be deducted for each bend is the difference between twice the radius and the length of the curve, or, for ½ in. pipe, using a 4.5 in. radius, approximately 2 in.

CARRYING CAPACITIES OF RUBBER INSULATED WIRES AND CABLES.

The accompanying table is arranged in the most convenient form for the practical use of architects, electrical contractors and engineers. It is original in its form and can be readily read directly by following the instructions. It gives a direct reading in amperes of the carrying capacity of direct current circuits.

Given any two of the three values—length, loss or load, the other may be found.

It is based upon the 1913 Edition of the National Electrical Code, "Table A of allowable carrying capacities of Wires." Rule 18.

It is also applicable for alternating current circuits when all the wires considered are in the same iron conduit.

The table is based upon the following formula:

$$(1).\ \text{cir. mils.} = \frac{L \times I \times 21.6}{V}$$

Cir. mils. = diameter of cable expressed in circular mils.

L = Length in feet—one way.
I = Load in amperes per wire.
V = Loss in volts.
21.6 = constant.

$$\text{The constant in table} = \frac{L}{I}$$

For example:
Cir. mils. = 200,000.
Length = 300.
Volts loss = 3.
Then substituting: in (1) we have:

$$200{,}000 = \frac{L}{I} \times I \times 21.6$$

$$200{,}000 = \frac{300}{3} \times I \times 21.6$$

$$2000 = I\ 21.6$$

$$I = 92.6+$$

The calculations in the table were carried out on a slide rule and there may be slight errors but results are near enough for all practical purposes.

Transformer oils and oil used for insulation purposes in oil-switches should be protected against moisture and should be free from acid, alkali and sulphur. The oil should not flash at less than 190 degrees C., as determined on the Gray flash-point apparatus, when intended for use in switches, but for transformers it may be 35 degrees lower. Transformer oils should not show any tendency to "sludge," due to oxidation of any of its constituents.

COST ACCOUNTING FROM THE ENGINEER'S STANDPOINT.

BY J. C. MARTIN.

(After a brief introductory statement the author suggests the necessary classification under which costs should be listed in general, together with specific illustration of classification for field, office and evaluation purposes. This article is slightly abridged from a paper presented before a joint meeting of the Portland Section of the American Institute of Electrical Engineers and the National Electric Light Association. Mr. Martin is engineer with the Pacific Power & Light Company.—The Editor.)

In the last few years the work of the efficiency expert, the evaluation engineer and the demands of the various public service commissions have brought a realization of the necessity for harmony between the engineering and accounting departments of public utility companies. The engineer has been brought to realize that proper accounting methods are as much a part of his work as the actual construction work and are just as important. The accountant has been brought to an understanding of the fact that a revolution in methods is necessary. The principles of accounting that he has had drilled into him must be applied in new ways.

As a result of this readjustment of ideas engineers and accountants with new viewpoints are being developed. The engineer must have a thorough working knowledge of accounting principles and methods, while the accountant must also have a thorough working knowledge of materials of construction, methods of organizing and carrying on construction work, handling labor, construction camps, commissary organizations, etc. The field of vision of both has been broadened.

As methods are only a means to an end and are capable of infinite variation, a statement of actual methods in use is of secondary importance, as it is seldom possible for one company to use in toto the methods of another company. Therefore only the general requirements that seem necessary on any construction job will be discussed here.

General Classifications.

The first requirement in any cost accounting system is a carefully worked out classification. On this depends the success of the whole system. No matter how carefully the accounting work is carried out, it cannot be otherwise than valueless if the classification is defective. Care must be taken in this classification in order to avoid including under each head more than one item which can be referred to a labor unit. For example, in a transmission line classification poles and wire cannot be successfully included under the same heading, as a confusion of labor costs would result. This is an exaggerated example but serves to illustrate the point. In general, the costs under each heading should be subdivided as follows:

(a) Cost f.o.b. factory.
(b) Transportation costs.
(c) Handling and hauling costs.
(d) Labor costs.

The labor costs may be subdivided into several heads. For example in a transmission line classification, the pole labor group may be subdivided as follows:

1. Framing.
2. Digging holes.
3. Erecting.
4. Painting.

In the majority of items, however, the labor costs will probably fall naturally in one group. The magnitude of the work involved will also determine to a large extent, the extent to which subdividing the classification shall be carried. Subdivisions that would be practical and useful in a large job would be utterly impractical in a small job because of the very small amounts involved.

It must be remembered that the more classification groups that are provided, the greater the complication and the greater the chance of errors creeping in. Therefore unnecessary subdivisions in the general groups and unnecessary groups under the general heads should be avoided. The problem deserves the most careful and painstaking consideration.

Field Classifications.

The principal records needed in the field are:

1. **Time Tickets.** There should be one each day for each man and the proper classification distribution as well as the nature of the work done should be shown.

I realize that it will be contended that time slips are an unnecessary complication and that it will be possible to make use of some modified form of time book. On extremely large work where large masses of men are engaged on the same work day after day, it may be possible to make use of the time book but the writer's experience so far is that on ordinary jobs the individual time ticket gives the most satisfactory results.

2. **Daily reports labor and Material:** These should cover all work done and material used. The units of work done together with the corresponding material used should be clearly shown and referred to the proper classification group.

3. **Material ledger:** This record is the one that usually provides the largest amount of grief but it is of the utmost importance and should show a complete record of all material received and issued. It should preferably be in the perpetual inventory form and frequent inventories should be made to keep down the chance of errors.

4. **Material received:** These should provide a complete record of material received from day to day, and are one of the sources of entry to the material ledger.

5. **Material and labor summary:** This summary provides the means of keeping a record of material and labor units, and should be arranged under the classification headings and should show the units of material used daily and the units of labor carried out daily. The material used will come from the storekeeper's ledger, while the labor units will be taken from the engineer's daily reports. This summary forms the basis of the "Daily Labor and Material Reports." It will be found on large jobs, especially those requiring a large amount of excavation, that the daily labor units will be on an estimated basis with an actual measurement taken at stated periods in order to check the daily estimates and provide the necessary corrections.

The foregoing records will form the main field records. Others will be required, viz., commissary reports, boarding and lodging reports, reports of agents handling cash, medical reports, etc. What is required depends on the size and nature of the job. No hard and fast rule can be laid down as to requirements.

Office.

The work of the office will consist of checking, summarizing and placing in permanent record form, the data received from the field force. It should also handle the payrolls. Each job should have a record of its own. The procedure will be approximately as follows:

Payrolls: The time tickets received should be summarized each day under their proper classification headings. At the end of the month a total summarization for each group and each job will be made as the payrolls are made up and closed.

Daily unit labor costs: This will consist of summarizing and bringing together the payroll charges and the labor units from the daily reports and provides the means of checking the cost of work from day to day and catching up and stopping leaks.

Construction ledger: This record forms the final record of the costs of the job and in it are centered under the proper classification heads, the charges for labor and material from the vouchers. The writer's own experience has been that the usual method of entering in the ledger the date, voucher reference and the total charges without any indication as to the nature of the material is not satisfactory as it affords no opportunity to check the charges without going to the vouchers. As the record is an original property record, it seems advisable to carry not only details of values but also of materials as well.

Monthly progress reports: This report is the point at which the labor and material charges from the construction ledger are brought together and matched against the units taken from the daily reports of labor and material. It serves to give the engineer in charge an adequate idea of what he has really accomplished and brings a realization of the cost of the work. If the classification is properly worked out, this report will provide a detailed analysis of the costs. This report should show not only the monthly costs but also the total costs to the given date.

The above outline is designed to cover the accounting features that are necessary from the standpoint of the construction engineer. The ordinary methods of handling invoices, vouchers, voucher records, control ledgers, cash expenditures, bank accounts, etc., will all come into play. Their use and place is so well understood that it is not necessary to comment on them here. This outline simply provides another link in the accounting chain that affords an adequate means of analyzing the figures and knowing what is actually being accomplished.

To put such a link as this in the accounting chain of any public service corporation will require a very large amount of careful study in order to make it fit in the most satisfactory manner. It will be necessary to provide supplementary reports and forms but these will be varied in accordance with the size and import-

ance of the work handled. With a record of this kind properly kept the transferring of the charges to the property accounts is a matter of detail only.

Property Evaluation.

An accounting link of this sort should be designed with both eyes fully open to the requirements of the evaluation engineer and the public service commission. Very many companies have found themselves in a serious predicament due to their inability to show from their records what their property has cost them. Figures in plenty have been available but in such shape as to render them almost valueless because of this impossibility of analyzing them and ascertaining their real meaning. A well kept record of each job along the lines suggested will do more to protect a public service corporation against the dangers of low valuations than anything else as it provides a record that can be gainsaid only on the score of needless extravagance and the record itself will go a long way toward eliminating needless extravagance because it constantly keeps the analyzed costs of the work before the eye and provides a real incentive toward economy. With a construction record of this kind property carried out, it will be possible to make a summary of the physical units and their costs for addition to an existing appraisal that can not be successfully gainsaid.

INDUSTRIAL USES OF FUEL OIL

BY F. B. DUNN.

Oil Fired Metallurgical and Shop Furnaces.

For many years engineers and scientists have been searching for a cheap and clean method of refining ore and bullion. While in a few instances electric furnaces offer a solution of the problem, the main reliance is still placed upon some form of fuel furnace.

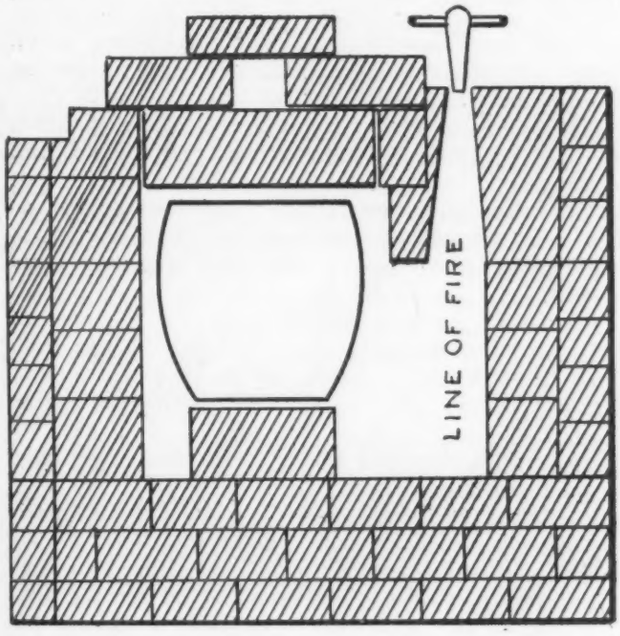

Fig. 71 Cross Section of Crucible Furnace.

Recent experiments have proved that oil meets all the requirements of such a fuel for metallurgical furnaces in which any kind of ore or metal is to be melted and refined.

Where the flame and gases are injurious to the metal treated muffle furnaces are used. These are made with one or more muffles. With a three-muffle furnace an assayer may do crucible work or melt in one muffle, scorify in the second and cupel in the third.

The results obtained from the use of oil by mining companies has been most gratifying. The manager of one large mine writes as follows:

"We have made one more melt with about the same results as we obtained in the test run. We used for a melt, 550 lbs. of precipitate, yielding about 6300 oz. metal (975 fine Au and Ag); 20 gal. of oil were required, compared with 1000 lb. of coke at $16.00 per ton. The oil cost 15c per gallon at the plant. The slags from the coke furnace used to run about $200.00 per ton, while those from the oil furnace run between $12 and $13; this obviates retreatment."

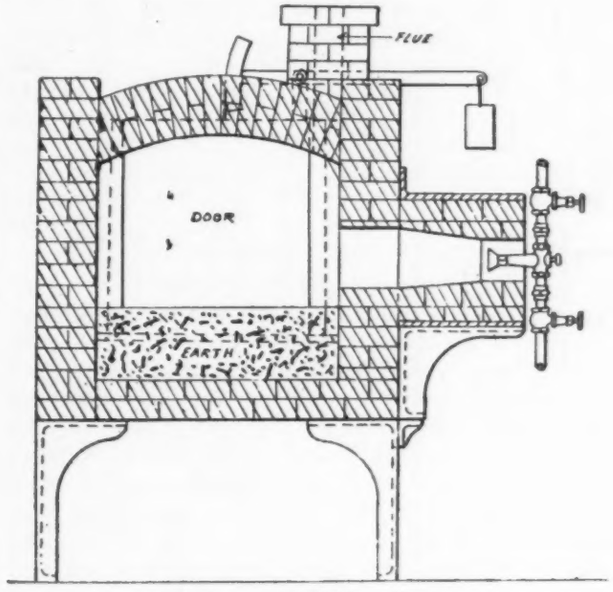

Fig. 72. Small Heating Furnace.

Other mines have submitted similar reports, showing much time and labor saved, and great economy effected, by the use of oil fuel.

Fig. 71 shows the method of constructing a crucible melting furnace. The size of the furnace required depends of course, on the size of crucibles used. The inner walls and bottom are built of a good grade of fire-brick, while common red brick may be used on the outer wall. The top may be made of arch and tapered fire-brick, held in place by an iron band. A small loop on each side of the band affords a means of raising the cover, in the center of which a small opening must be left for charging or adding flux as required.

Almost any type of an oil burner can be applied to this furnace, the low pressure air type being the most suitable. It will maintain a temperature of over

3000 deg. F., with a fuel consumption of only 3 gallons of oil per hour, using air at 2 lb. pressure. Two gallons of oil will melt 100 lb. of brass scrap in about 30 minutes, and crucible steel, brass, copper, bronze, silver, gold or nickel can be melted with similar economy and convenience.

Fig. 72 shows a small heating furnace, that is easily made. Doors may be placed at either end. Fig. 73 shows a rivet heating furnace, which may also

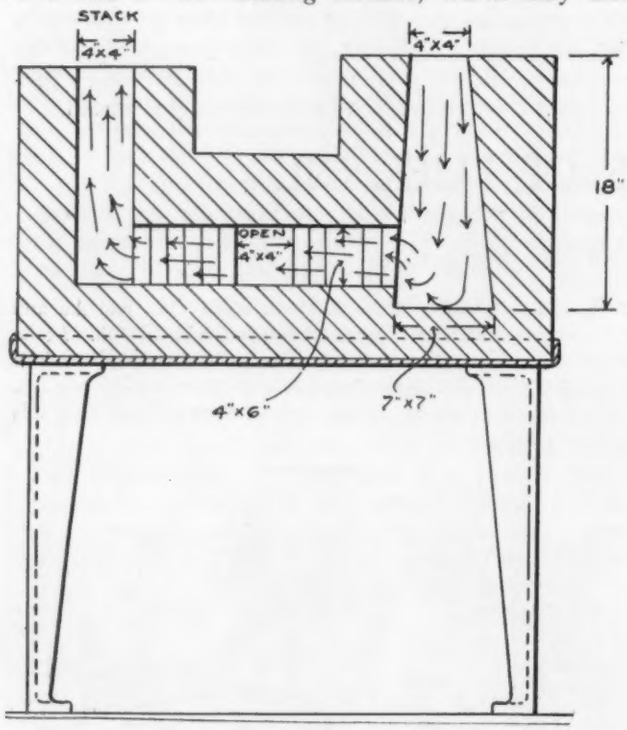

Fig. 73. Rivet Heating Furnace.

be used for tempering, annealing, case hardening, etc. This type of furnace can be run 8 hours on less than 20 gal. of oil. The furnace illustrated is designed to use compressed air for atomizing, for where riveting is being done, compressed air is generally available. In operation, the furnace is first started and thoroughly heated. Then the oil is shut off and about 12 or 20 rivets are thrown in, depending upon their size. The rivets must not lie in a heap, but be spread over the bottom of the furnace. The oil is then turned on, and in a few moments the rivets will all be heated to a uniform temperature. When they are driven they will thicken up and fill the hole, and the head and back will form squarely over the rest of the rivet. Being uniformly hot, the iron is left in good condition and the stress is evenly distributed throughout the rivet, making a good steam tight job.

The heat treatment of steel is one of the most important operations to which it must be subjected before use. Over 90 per cent of all the steel made is heated after conversion, either for the purpose of bringing it into a mobile condition in which it can be readily worked, or for annealing. In working steels it is important that they be properly heated, for careless treatment at this period will produce working parts that are inferior even with original material of the highest grade. A great majority of the steel forgings thrown into the scrap heap are the ones which have been misused in the furnace, rather than the ones made from defective material or spoiled by the hammer.

Many good pieces of steel have been ruined by defective annealing furnaces. The operations of annealing, hardening and tempering steel must be conducted with great care, and require a special furnace, in which the air used for combustion is carefully regulated, to prevent the oxidation of the steel being treated.

[To be continued.]

LETTER TO THE EDITOR.

The Diesel Engine.

Sir: I have been much interested in the written discussion of my paper on the Diesel engine. I had heard the discussion at the meetings but did not have time to answer it.

The following would be a fairer heat balance than the one that I gave in my paper.

4 Cycle Diesel Engine.	Per cent.	Steam Turbine.	Per cent.
B.H.P.	34	B.H.P	20.
Friction	10	Friction	1.
Cooling water	28	Exhaust	60.5
Exhaust	28	Auxiliaries	3.5
		Stack	8.
		Boiler rad	4.
		Burners	3.
Heat in fuel	100	Heat in fuel	100

This heat balance is a limiting condition which cannot be quite reached in practice today, unless the plant is operating under test conditions.

My costs of operation of the Diesel engine are criticized by steam engineers as too low while Diesel engineers say they are too high. Therefore I believe that they represent the average conditions as well as they can be represented at present. The deviation of single plants from this average may be a very large amount.

Some of my assumptions regarding the cost of fuel oil in Diesel plants were purposely placed high so as to show the advantage of the Diesel (if there were any) when it was handicapped with a high price of oil.

Messrs. Cohle and Royer overlooked one thing in their criticism of my paper. The efficiency that they criticise as being too high for a 600 kw. plant was never intended for such a plant and there was no statement in my paper to that effect. I used outputs of 140 and 447 kw.-hr. per barrel of oil for the two plants which give an efficiency of about 8 per cent for the steam plant and 26 per cent for the Diesel plant.

Messrs. Cohle and Royer make the statement that electrical energy may be bought for 1.1 cents per kw.-hr. from the central station companies. If this can be done it is cheaper than for a small plant to make the energy. But they overlook one point and it is very important. No central station was willing to sell electrical energy for 1.1 cents per unit until the isolated plants and municipal plants forced them to do it. Also they would probably refuse to do so if all the small plants should buy their energy from a central station and there were no regulation of rates by a public service commission of some kind.

Very truly yours,

W. H. ADAMS,
Prof. Mech. Eng.,
Throop College of Technology.

Pasadena, Cal.,
March 24, 1915

STRAIGHT LINE ENGINEERING DIAGRAMS

Flow of Water in Pipes.

In connection with the many illustrations of straight line engineering diagrams which have been published a paper on "Nomographic Solutions for Formulas" presented at the February 3, 1915, meeting of the American Society of Civil Engineers by R. C. Stracham is of interest. This paper is presented in the December, 1914, Proceedings of the Society and contains the accompanying charts for the solution

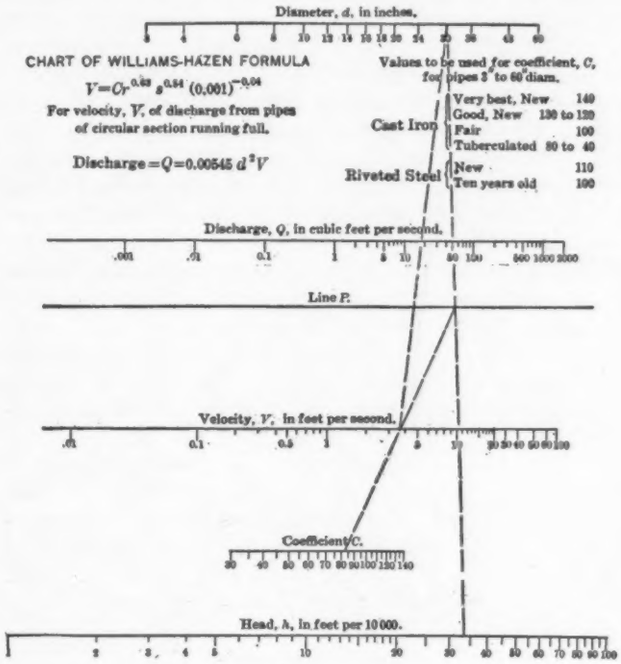
Diameter, d, in inches.
CHART OF WILLIAMS-HAZEN FORMULA
$V=Cr^{0.63}s^{0.54}(0,001)^{-0.04}$
For velocity, V, of discharge from pipes of circular section running full.
Discharge $=Q=0.00545\,d^2V$
Values to be used for coefficient, C, for pipes 2" to 60" diam.
Cast Iron
Very best, New 140
Good, New 130 to 120
Fair 100
Tuberculated 80 to 40
Riveted Steel
New 110
Ten years old 100
Discharge, Q, in cubic feet per second.
Line P.
Velocity, V, in feet per second.
Coefficient C.
Head, h, in feet per 10000.

Fig. 1.

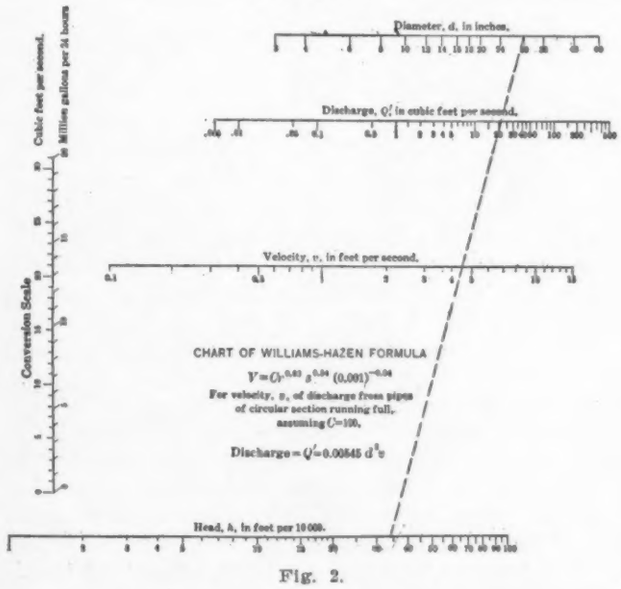
Diameter, d, in inches.
Discharge, Q', in cubic feet per second.
Velocity, v, in feet per second.
Cubic feet per second.
In Million gallons per 24 hours
Conversion Scale
CHART OF WILLIAMS-HAZEN FORMULA
$V=Cr^{0.63}s^{0.54}(0.001)^{-0.04}$
For velocity, v, of discharge from pipes of circular section running full, assuming C=100.
Discharge $=Q'=0.00545\,d^2v$
Head, h, in feet per 10000.

Fig. 2.

of the Williams-Hazen formula for the flow of water in pipes. In the formula as shown on the chart

V = velocity in feet per second;
r = mean hydraulic radius.
s = slope or ratio of rise to length;
C = a coefficient depending upon the condition of the inner service of the pipe.

The quantities **r** and **s** are exposed on the lines of the chart in terms of **d**, the diameter of the pipe in inches and **h**, the head of feet in 10,000 ft.

In Fig 1, assuming that **d** and **h** are known and a value of **C** selected according to the condition of the pipe, place a straight edge so as to connect **d** and **h** and mark its intersection on "Line **P**." Connect this point with the selected values of **C** and at the intersection on the **V** line read the value of **V** in ft. per sec. Then connect this **V** with the given **d** and at the intersection on the **Q** line read **Q** in cu. ft. per sec.

By changing this process, either of the four quantities, **d, h, V.** or **C** may be obtained when the other three are given. The broken lines drawn on the chart show that when **d** = 30 in., **h** = 33 ft., and **C** = 82, the formula gives **V** = 3.7 and **Q** = 18. cu. ft. per sec.

In Fig. 2, **C** is assumed as 100 and one placing of the straight edge is sufficient to show the desired quantities. By means of the "conversion scale" cu. ft. per sec. may be read off at once in million gallons per day. The broken lines show that when **d** = 30 in. and **h** = 33 ft., **v** = 4.5 and **Q'** = 22. cu. ft. per sec.

WATER POWER POSSIBILITIES IN OREGON.

According to advance copies of the 1914 Oregon Almanac, the estimate of Leonard Lundgren, Hydro-electrical Engineer in the Forest Service, with headquarters at Portland, Oregon, gives the rated capacity of the plants already installed and operating in the state of Oregon as 160,000 h.p., of which 106,760 h.p. is operated in Clackamas county. A tentative estimate made by the U. S. Geological Survey, places the water power resources of Oregon at 3,500,000 h.p.

The latest reports show that the existing markets are abundantly supplied; but the various power companies are indicating their optimistic viewpoint in regard to the future growth of their business by making engineering studies on undeveloped sites, and thereby preparing for additional demands for electric power. These demands will arise with the increase in population and with the growth of manufactures. The public utilities supplying the Portland market have prepared for this future growth through the installation of machinery to furnish 30,000 h.p. in excess of the present demand.

A rare chemical exhibit is on display in the booth that the Welsbach Company has in the collective gas exhibit in the Manufacturer's Palace of the Panama-Pacific International Exposition. These include all the minerals and chemicals which are obtained from zircon or monazite sands in separating the thorium, cerium nitrate and other chemicals used in the manufacture of gas mantles. The list comprises praseodymium ammonium nitrate, neodymium ammonium nitrate, lanthanum ammonium nitrate, aluminum nitrate, magnesium nitrate, cerium oxalate, cerium fluoride, mesothorium residues, beryl from Colorado, zircon sand from North Carolina, zircon from North Carolina, monazite sand from Brazil and North Carolina, thorium nitrate, cerium nitrate, beryllium nitrate, zirconium nitrate, fixing fluid, lighting fluid, collodin solution and stamping fluid. Many of these products are seldom seen by laymen or even by chemists.

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POWER AND GAS

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Electrical Prosperity Week

Plans are rapidly being perfected for a week of concentrated sales and educational effort by the electrical industry. Under the auspices of the Society for Electrical Development representatives from each of the branches of the business have discussed tentative arrangements and decided that it will be best for all concerned to inaugurate this intensive campaign about December first.

Although this proposal was made less than three months ago it has met with such instant and favorable response that its success is already assured. A committee representating the manufacturers, jobbers, central stations and technical press is making the preliminary plans which are to be carried out by the Society for Electrical Development with the active co-operation of committees in each geographical center. Four strong committees are to be formed on the Pacific Coast, the names to be announced after the next executive committee meeting in April.

The first week of December is particularly appropriate for a movement like this. The lighting season is at its height, people are doing their Christmas shopping and the brilliant suggestion of an electrical Christmas can be pleasingly and forcibly impressed on their minds. In order to be truly effective the plan should receive the hearty endorsement and encouragement of every electrical man. The united effort of thousands of men all over the country for one week will be of great assistance in teaching the people to "do it electrically."

Electrification of the Home

The old adage, "despise not the day of small things," is worthy of the earnest consideration of every electrical man. At one time it was the ambition of the salesman to sell heavy apparatus. The efforts of the great manufacturing companies were concentrated on the sale of large generators and transformers and small apparatus and lamps were given minor attention. Today the conditions are reversed. Every effort is being made to increase the number of lamps and appliances in daily use, with the knowledge that the current demand thus created will compel the installation of more generating machinery. From the central station standpoint this means developing the market before developing the power, just as the ore in a mine should be blocked out before a mill is built.

Five years ago many central stations were opposed to the introduction of the high-efficiency tungsten lamp, arguing that it would materially reduce the current consumption. Now that they realize that it reduces the lighting peak, thus making it possible to serve more consumers without increase in station equipment, they are according it a most cordial reception. The tungsten lamp has also made possible material reductions in rates, as the lighting load is the most expensive and undesirable service that a company is called upon to care for.

This change has been made possible largely by the introduction of the heating device and motor-driven appliance, which not only increase the total consumption of the average family, but spreads it throughout the day so as to cause a more uniform demand. Both the heating device and the small motor

seem destined to large sales in the future and offer a logical means of absorbing surplus power.

To the small motor, particularly, must the housewife look to the solution of the vexing "servant problem." It not only shortens the hours of labor but makes house work a positive pleasure. The engineering problems involved in the electrification of the home are even more exacting than those which have been overcome in the electrification of factories, railroads and mills. Likewise they are far more important in the social welfare of our people, many of whom are unfortunately losing the ideals of the home because the modern woman rightfully refuses to be a drudge. The next few years will, however, witness a "back to the home" movement compared to which the "back to the farm" movement will not be a circumstance. And electricity is the potent agent which makes it possible, by taking the drudgery out of house work.

Electrical men are familiar with the steps which have brought about the change, particularly the development of a small single-phase motor which is at once efficient and fool-proof. The various simplifications in the design of the motor and its control have made it reliable and safe in the hands of the most ignorant kitchen mechanic.

There is one problem, however, which has not yet been completely solved and until this is worked out the high initial cost of several small motors, each driving a different appliance, will retard the general use of motor devices. More than two or three motor-driven appliances are seldom used simultaneously in the average home. The housewife wants a light, portable motor that can be carried to the different machines as they are in use on different days. There is no fundamental reason why it is necessary to have a different motor to operate the washing machine and the mangle, why the vacuum cleaner requires one motor and the sewing machine another, why the same motor cannot be used every day for the dish washing machine and occasionally for the ice cream freezer. The waste of duplication involved in employing different motors for the electric fan and the coffee grinder, egg beater or meat chopper is unnecessary. Considerable progress has already been made in this direction, as exemplified by the "motor-table," but perfection is still far from attainment.

Building Better Public Relations

Officials in every branch of the quasi-public service are fast awakening to the importance of better relations with the public. As a part of the annual report of the American Telephone & Telegraph Company Theodore N. Vail president of the company, states "until proper relations are established between the public and the public utilities there cannot be too many repetitions of their importance. No effort should be spared to emphasize it and guide the public to the right conclusions. Until popular misunderstandings are corrected it will be difficult to establish proper relations." Nor for a time, at least, can there be too much emphasis laid upon the necessity, also, for every public official realizing the necessity for campaigns to improve these relations.

Mr. Vail's company has long been conducting such a campaign which is an excellent example of what other utilities should do. The public is being gradually educated as to the factors which enter into the cost of telephone service and how that service is being improved. With such knowledge comes confidence and a reaction against the present practice of baiting big business.

The prerequisite of a campaign of this character is a thorough house-cleaning on the part of the utility. A few windows should be opened in the side-walls, so that the public can look in and see what is going on. Otherwise they will remain suspicious as to the doings in the windowless offices of public service corporations. Any publicity is worse than useless until every source of complaint and distrust has been removed. "Remove the beam in your own eye before pointing out the mote in that of your neighbor."

This text also gives the cue as to how the public should be regarded. An abstract conception of the public is sometimes difficult to formulate. But if they be thought of as neighbors that have the same problems and are swayed by the same motives "even as you and I" it is usually possible to make an effective plea. For instance, appeal to the self-interest of your neighbor. Show him how he has been benefited by your service and how he and all his friends, who should likewise be your friends, are hurt when you are unjustly attacked. Talk to him as an individual, man to man, and eliminate the cold, impersonal attitude.

The utility and the community are mutually independent. What hurts one, injures the other. An enforced reduction in revenues and an increased cost of service where there is no possibility of introducing further economies works more harm to a city than to the corporation affected. Corporation activity means the employment of men, puts more money into circulation, causes more food and material to be bought, thus spreading out in ever-widening circles. Stagnation of capital creates the reverse condition. The interests of the public and the interests of the public utilities are identical.

These facts are being gradually realized by the heads of the big companies. The American Electric Railway Association plans to inaugurate work along these lines in the near future and the National Electric Light Association has similar plans in contemplation. At a recent meeting of the Illinois Section of the American Water Works Association, Mr. C. S. Hadden in a paper on "The Practical Value of Publicity Work to the Waterworks Man" summarized methods of successful effort as follows:

Readable annual reports, pamphlets on specific subjects, reading notices in local newspapers, formal newspaper advertising, addresses delivered to civic organizations, and specially to high school students, departmental meetings or schools, reports of which filter into the newspapers; posters and hand bills for emergency notices.

It is necessary to go out in the highways and byways and preach the gospel of service. Whereas five years ago this suggestion was as a voice crying in the wilderness, the need is now universally evident. Its accomplishment requires men of a different type from those who constructed the plant. The call is not for the driver, but the diplomat, the man who understands human nature and how it can be led in the right direction,—educated.

PERSONALS

O. L. Coward, sales agent of the power and mining department of the General Electric Company, has returned to Juneau, Alaska.

G. L. Lowman, district auditor of the General Electric Company, was a recent Seattle visitor on business for his company.

H. E. Plank, agent in charge of the Seattle office of the General Electric Company, was at Portland during the past week.

Ross Hartley, manager of the Portland office of the Pacific States Electric Company, has returned to Portland from a trip to California.

E. B. Walthall, assistant general manager of the San Joaquin Light & Power Co., Fresno, spent several days on a business trip to San Francisco.

R. H. Coyne, representative of the Kellogg Switchboard & Supply Co., San Francisco, left the early part of the week for a business trip through California.

T. E. Burger, manager of the Los Angeles office of the Western Electric Company, has returned to Los Angeles after visiting the exposition at San Francisco.

R. F. Behan, of the sales department of the Westinghouse Electric & Mfg. Co., at San Francisco, has returned from a several days' trip through the San Joaquin Valley, California.

J. M. Morris, manager of the detail and supply division of the Westinghouse Electric & Manufacturing Company, at Los Angeles, was at San Francisco during the past week.

C. M. Parr, general sales manager of the Hart & Hegeman Manufacturing Company, Hartford, Conn., is at San Francisco on a business trip of the Pacific Coast.

H. A. Laycock, general office engineer of the General Electric Company, Schenectady, N. Y., is a recent arrival at San Francisco on business of his company.

F. V. Burton, eastern sales manager of the Bryant Electric Company, Bridgeport, Conn., who is making a business trip of the Pacific Coast, is at present at San Francisco.

C. O. Brown, local manager of the Mountain States Telephone & Telegraph Company at Montpelier, Idaho, has been assigned to the Idaho Falls, Idaho, exchange, with supervision over the exchanges at Rigby and Shelly.

C. M. Clark, chairman of the board of directors of the Portland Railway, Light & Power Company, was at San Francisco during the past week visiting the Exposition while on his way to Philadelphia from Portland.

H. H. Shields, formerly superintendent of transmission for the Sierra & San Francisco Power Company, has succeeded **S. W. Dietrich,** resigned, as electrical superintendent for the Fresno district of the San Joaquin Light & Power Corporation.

J. P. Simpson, for a number of years connected with H. M. Byllesby & Company properties, and until March 15th auditor of the Everett Gas Company, has been appointed to the position of treasurer of the Tacoma Gas Company, to fill the vacancy caused by the promotion of **R. C. Coffy** to manager of the Everett Gas Company. **J. G. Bourus** will become auditor at Everett.

R. Cardiff, general superintendent of the Coast Counties Gas and Electric Co., and **Messrs. Schoenbacher,** district manager at Watsonville; **Sherman,** district manager at Hollister; **Van Britton,** gas engineer, and **Von Bocklin,** electrical engineer, formed a party of that company's officers that spent several days at San Francisco, during which they made an inspection trip to the Exposition.

H. G. Johnson, formerly in charge of telephones and the electric time system of the B. C. Electric Railway Company, Ltd., at Vancouver, B. C., has left for England and expects to remain there in business. Mr. Johnson is an associate of the A. I. E. E. and an active member of the N. E. L. A., and made a great number of friends in the central station industry who will regret his departure.

MEETING NOTICES.

Alameda County Electrical Development League.

At the regular monthly meeting on March 27th at the Key Route Inn, Oakland, R. M. Alvord discussed conditions and relations between central stations, the jobber, the retail trade and the customer.

The Portland Jovian League.

At the regular luncheon on Friday, March 26th in the crystal room, Hotel Benson, Portland, Oregon, the speaker of the day was Mr. Frank Brouch Riley and his subject was "Our Proposed Highways and Their Effect on Tourists and Industrial Travel." Music was furnished by the Hyatt Talking Machine Company's most modern phonograph. Mr. Riley said in part: "Good roads are the test of civilization. In the past the farmers have been opposed to good roads as they did not think motor vehicles should use them, but this prejudice is disappearing. If all the roads in the United States were hard surfaced the saving to the American farmer, in one year, would amount to enough to build the Panama Canal and fortify it."

San Francisco Electrical Development and Jovian League.

Last Wednesday's meeting was Westinghouse Day at the League, and probably one of the most enjoyable and best attended meetings of the year. Mr. Carl Heise, manager of the local branch of the Westinghouse company, presided as chairman of the day and provided some delightful vocal and instrumental talent, after which the speaker of the day, Mr. James K. Lynch, vice-president of the First National Bank, was introduced. Mr. Lynch told of the various problems confronting the banking world from the standpoints of the savings, commercial and trading business and the bearing the Federal Reserve Banks would have upon it and periodical panic conditions. He explained that the Federal Reserve Banks were banks for bankers and should obviate panics because credit will not be arbitrarily withdrawn. In his estimation it will be five years before this new credit machine will be in smooth running order. At the conclusion of the meeting a vote of thanks was extended to Mr. Heise and Mr. Lynch.

California Ass'n of Electrical Contractors and Dealers.

The regular monthly meeting was held at the Hofbrau Cafe, San Francisco, March 19. President C. F. Butte introduced J. Carlson of the Central Electric Co. as chairman of the day. Mr. Carlson, after a few remarks, stated the object of the meeting and then introduced W. H. McLaren of the General Electric Co., who rendered a number of Scotch selections. Stanley Walton of the Pacific Gas & Electric Co. was then introduced and spoke on what could be accomplished by team work and getting together. The next speaker was Dave Harris of the Pacific States Electric Co., who dwelt on the demoralization of the electrical business and what the jobbers were trying to do to correct it. R. M. Alvord of the General Electric Co' then followed, giving a description of the "Home Electrical" at the P. P. I. E., and how the General Electric Co. expected the same could be of use to the electrical contractors and dealers. Ross Hartley of the Pacific States Electric Co. at Portland gave the contractors of the Bay section an idea of what was going on at Portland.

L. C. Ames of the National Electric Co. spoke on the negative side of what the Contractors' Association was doing to better business. Mr. Ames was answered by C. F. Butte, president of the Association; C. C. Hillis, manager of the Electric Appliance Co.; R. D. Holabird, of the Holabird-Reynolds Co., and Murray Orrick, of the Western Electric Co. The concluding talk of the evening was given by W. L. Goodwin, vice-president of the Pacific States Electric Co., on policies which

that company was working on and intended to put in force in the future. Secretary W. S. Hambridge thanked the gentlemen for being present and gave notice of next meeting for Oakland, April 16. Some forty members were present.

Jovian Electrical League of Southern California.

The weekly luncheon of the League, held at Christopher's, Los Angeles, on March 24, was attended by over one hundred Jovians and a number of local and out-of-town guests. After these had been publicly introduced, Tribune Pieper discovered that a number of Jovians did not wear their identification badges or were not acquainted with their neighbors to the right and left of them, and in each case the "charity fund" was enriched by ten cents, the fines being cheerfully paid by the offenders. A letter from the San Francisco League was read, in which an invitation was extended to the local Jovians to attend the League's coming rejuvenation. There were three-minute talks by R. R. Thomas on Don Paramore and F. G. Lasher on L. P. Lenone. The chairman of the day, Don D. Morgan, then introduced Frank S. Daggett, Director of the Museum of History, Science and Art at Exposition Park, who gave a most interesting talk on the celebrated "La Brea Deposits," which have attracted the attention of the scientists throughout the world. The fossil beds contain animals of many prehistoric periods, such as imperial elephants 14 feet high, larger than any other mammoth, and which must have lived at least 200,000 years ago. A tree, the pores of which were filled with a light volatile oil, was discovered and a carload of bones was imbedded around it. In one pit were found African lions, camels and bison. The climate, judging from cyprus cones found, must have been like that of Southern Wisconsin. Birds with a spread of wings of about 15 feet were located and five species of eagles, also about 600 sabretooth tigers and many animals which were physically disabled before falling into the pits. Much careful work has been done in the territory, covering thirty acres, and many photographs were taken, so that the relation of every bone to all the others can be accurately determined. In the summer, when thousands of members of the Society for the Advancement of Science will visit Los Angeles, the pits will be kept open for inspection and actual excavating will be done for the benefit of the visitors. The musical program at the meeting consisted of the rendition of several solos by Grove T. Vail, with Dick Alter presiding at the piano.

INTERNATIONAL GAS CONGRESS.

Plans are rapidly being perfected for the International Gas Congress which is to be held at San Francisco, September 27-October 3, 1915. The entire fourth floor of the great municipal auditorium has been reserved for the exclusive use of the congress. There are two halls 58 by 138 ft., each of which may be changed into five smaller halls seating 250 people. There are also two halls 41 by 64 ft. directly connected with the large halls, as well as two committee rooms.

It is proposed to have sessions of the congress each day beginning Monday, September 27th, from 10 a. m. to 1 p. m., leaving the afternoons open for the annual meetings of the various gas associations, and allowing time to visit the exposition and other points of interest.

Dr. Alex C. Humphreys, past president of the American Gas Light Association and American Gas Institute, and Miller, Inc., Buffalo Gas Company, and Stevens Institute of Technology, has been elected president of the congress, with the presidents of the participating gas associations as vice-presidents. These associations are: American Gas Institute, Empire State Gas & Electric Association, Guild of Gas Managers of New England, Illinois Gas Association, Illuminating Engineering Society, Indiana Gas Association, International Acetylene Association, Iowa District Gas Association, Michigan Gas Association, National Commercial Gas Association, Natural Gas Association of America, New England Association of Gas Engineers, New Jersey State Gas Association, Pacific Coast Gas Association, Pennsylvania Gas Association, Society of Gas Engineering of New York City, Society of Gas Lighting, Southern Gas Association, Southwestern Electrical & Gas Association, Wisconsin Gas Association.

England was the first foreign country to officially accept the invitation to participate in the International Gas Congress. At the meeting of the Council of the Institution of Gas Engineers of England, it was voted to participate, and Mr. Edward Allen, M. I. C. E., a past president of the institution was named as the delegate to the congress to represent the Institution of Gas Engineers of England.

The details of the congress are in the hands of subcommittees of the joint committee in the East, covering the departments of Arrangements, Publicity, Transportation and Invitation; and the committee on Papers, under the chairmanship of Alten S. Miller, is busily engaged in securing papers from representative gas men throughout the world, covering all fields of activity in the industry. The local arrangements for the congress are being handled by a committee, of which Mr. John A. Britton of San Francisco is chairman. The necessary arrangements at the meeting, of halls, registration, care of baggage, local transportation, hotel accommodations and the reception and entertainment of visitors, etc., are to be handled by sub-committees made up from members of the Pacific Coast Gas Association.

The personnel of the Gas Congress Committee of Pacific Coast Gas Association, as of March 23, 1915, is as follows:

John A. Britton, chairman, 445 Sutter St., San Francisco.
E. C. Jones, Pacific Gas & Electric Co., 445 Sutter St., S. F.
Chas. F. Adams, P. O. Box No. 8, Portland, Ore.
John Clements, Pacific Gas & Electric Co., Oakland, Cal.
M. C. Osborn, Washington Water Power Co., Spokane, Wash.
W. A. Aldrich, 23 N Lafayettte St., Grand Rapids, Mich.
L. P. Lowe, 626 Pacific Building, San Francisco.
John Martin, 454 California Street, San Francisco.
C. O. G. Miller, 519 California Street, San Francisco.
W. B. Cline, Los Angeles Gas & Elec. Corp, Los Angeles, Cal.
F. A. Leach Jr., Manager Pacific Gas & Elec. Co., Oakland, Cal.
Wm. Baurhyte, vice-president, Los Angeles Gas & Elec. Corp., Los Angeles, Cal.
C. S. Vance, third vice-president Los Angeles Gas & Elec. Corp., Los Angeles, Cal.
Geo. C. Holberton, manager San Francisco District, Pacific Gas & Electric Co., San Francisco.
F. A. Cressey Jr., manager, Modesto Gas, Light, C. & C. Co., Modesto, Cal.
Geo. H. Collins, vice-president Pacific Lighting Corporation, 519 California St., San Francisco.
W. P. Hutchingson, vice-president Sprague Meter Co., Bridgeport, Conn.
C. B. Babcock, General Gas Light Co., 768 Mission St., S. F.
D. E. Keppelmann, Pacific Gas & Electric Co., San Francisco.
Leon B. Jones, Pacific Gas & Electric Co., San Francisco.
A. H. Halloran, managing editor Journal of Electricity, Power and Gas., 618 Mission St., San Francisco.
R. J. Thompson, Welsbach Co., 863 Mission St., San Francisco.

EXAMINATION FOR MINE ELECTRICIAN.

The United States Civil Service Commission announces an open competitive examination for mine electrician, for men only, on April 28, 1915, to fill a vacancy in the Bureau of Mines, for service in the field at a salary ranging from $1200 to $1500 a year. The duties of this position will be to make investigations bearing upon the safety of electricity in mines and the causes of mine disasters for which electricity may have been responsible. The duties will involve considerable field work and travel.

Competitors will be examined in: Practical questions in mine electrical practice (mine lighting, distribution, wiring, hauling and hoisting apparatus and equipment) (50 points). Thesis or reports (20 points). Education and experience (30 points). At least one year's study of electrical applications in a technical school of recognized standing and five years in actual underground electrical work in mines, are prerequisites for consideration for this position.

ELECTRICAL JOBBERS' CONVENTION.

More than sixty Pacific Coast electrical jobbers, with their guests, held a three-day session at Del Monte, March 25, 26 and 27. As usual, golf was the chief occupation and the one topic of conversation, notwithstanding the fact that occasional showers necessitated playing off some of the matches in the rain. As the meeting was graced by the presence of a dozen or more ladies, there was also much enjoyable dancing. These doings, with cards, billiards, pool and the other sports afforded by this ideal meeting place, combined to make the convention one long to be pleasurably remembered.

On Friday evening H. H. Cudmore, director of the Mazda Bureau of the General Electric Company gave a lantern slide lecture on the illumination of the Panama-Pacific International Exposition. He and W. H. McLaren also entertained the company with some fine singing.

The open meeting on Saturday afternoon was broadened in scope by the presence of two representatives from central stations, in addition to the manufacturers and jobbers. The discussion, which was entirely informal in nature, was opened by H. V. Carter, chairman of the meeting, and for want of a better title was devoted to a consideration of the troubles of the electrical business and how they can be remedied.

As a general corrective Mr. Carter urged that each branch of the industry lend its aid in helping each of the other branches. He suggested that the manufacturers should put value into their product, with less emphasis on price; he stated that central stations and contractors should buy from local stocks as carried by jobbers, not only because of the better service offered, but also because of the good will thus created; and he believed that it is the duty of the manufacturer, central station and jobber to educate and assist the contractor and dealer. Each set of men is in a position to help the other far more than the others can help themselves.

As a specific illustration of the jobbers' difficulties, R. D. Holabird cited instances where manufacturers had reduced prices on electrical supplies to such a point that there was not a sufficient margin to enable the jobbers to continue their creative sales work. He pointed out that this profit reduction was not in percentage but in money actually received; that the present cash profit on switches, for example, is now less than one-sixth what it was a few years ago. This viewpoint was emphasized by other jobbers present, including T. E. Burger, C. C. Hillis and W. S. Berry.

The manufacturers' standpoint was voiced by W. S. Seaver, Garnett Young, T. E. Bibbins and C. M. Parr. Past restrictions have prevented manufacturers from getting together to discuss this difficulty and its rectification. The most important remedy suggested was general education as to the desirability of a higher standard of goods. It was urged that the manufacturers agree on a set of specifications for architects setting a high standard, and that efforts be directed along constructive rather than destructive lines. It was also demonstrated that as the selling price of all kinds of electrical supplies was going down, the cost of selling was going up, and at the present rate would soon be equal. The manufacturers feel that they have suffered more than the jobbers and that these price reductions have been forced upon them.

George C. Holberton compared this situation to that of the central station industry, showing that in both cases the dollar return was being gradually reduced until the profit was being absorbed by the service charge. He spoke of the readiness to serve or demand charge which must prevail in all branches of the electrical business and must precede any energy or supply charge.

Mr. Holberton likewise believes that the consumer should be educated as to the cost of doing business and the value of the service rendered. He showed how the so-called "minimum charge" was a payment for services actually rendered. Emphasis was laid on the fact that during 1913 there were less than 2 per cent returns on the investment which has been made in the system of the Pacific Gas and Electric Co. and spoke of the dangerous features of the new public service commission law, one of whose sections provides that the ownership of public utility property is to be classed as a "question of fact" and as such there can be no appeal from the decision of the commission.

He stated that if the Spring Valley Water Co. were purchased by the City of San Francisco the administration planned to use the earnings in equipping a generating plant and transmission system to bring power from the Hetch Hetchy development for the operation of the municipal electric railway and for street illumination. Yet it is said that the entire revenue from the sale of this current at present rates would not be sufficient to pay interest on the cost of the investment. The current could be generated by steam in San Francisco much cheaper than by water power in the Sierras and then transmitted to San Francisco unless an intervening market is developed. In response to Mr. Holberton's request the support of the jobbers was pledged in making these facts known.

S. M. Kennedy, general agent for the Southern California Edison Co. of Los Angeles, gave an extended talk on the conditions which have arisen in connection with the proposed acquisition of the Los Angeles distributing system of this company as a means for distributing aqueduct power. He also expressed his belief in the policy that the central stations should devote their energies to the sale of current and should not sell lamps and appliances.

To correct the unprofitable condition of every branch of the electrical industry, Mr. Kennedy urged education of the public as to the advantages of electricity and a more intense development of the business. His experience has proved that by education and good salesmanship more appliances can be sold at list price than by the unaided appeal of cut prices.

W. L. Goodwin summed up all that had been said in the light of the prevalent attacks on big business and argued that, like the European war, it will not be stopped until the cause is removed. Though the immediaate cause of most of this trouble may be the politician, he is only giving the people what they want. The people are dissatisfied with the treatment that big business has accorded them in the past, and it is now absolutely necessary for the corporations to find out where their actions are distasteful to the public and then correct these complaints.

The meeting was brought to a close by the regular golf dinner on Saturday night. Garnett Young presided as toastmaster and set a high standard for the flow of wit which enlivened the dinner. R. D. Holabird was called upon to wish a speedy recovery for Albert Elliot, the secretary. The jobbers' copper cup and its accompanying Del Monte trophy was presented D. L. Reynolds, the winner, by W. L. Goodwin. The Pass & Seymour cup was presented by H. V. Carter to F. H. Leggett, who also won the pool tournament, while Mrs. Leggett won the bridge prize. W. Brewster Hall won the manufacturers' cup. C. E. Heise gave an interesting talk on business conditions and announcement was made by T. E. Bibbins that a number of manufacturers would put up a new cup at the next meeting, to be competed for in match play.

The list of those present at the meeting included:

Mr. and Mrs. T. E. Burger, Western Electric Co., Los Angeles.
Miss Owen.
Mr. and Mrs. W. S. Berry, Western Electric Co., San Francisco.
Mr. and Mrs. A. H. Elliot, Jobbers' Ass'n., San Francisco.
Mr. and Mrs. I. J. Francis, John Roebling's Sons Co., L. A.
Mr. and Mrs. C. E. Heise, Westinghouse Elec. & Mfg. Co., S. F.
Mrs. Kerrigan.
Mr. and Mrs. R. D. Holabird, Holabird-Reynolds Co., S. F.
Mr. and Mrs. C. C. Hillis, Electric Appliance Co., San Francisco.
Mr. and Mrs. Hal. Lauritzen, Holophane Co., San Francisco.
Mrs. Pounder and W. R. Pounder, Hubbard & Co.
Mr. and Mrs. F. H. Leggett, Western Electric Co., San Francisco.
Mr. and Mrs. S. P. Russell, H. W. Johns-Manville Co., S. F.
Mr. and Mrs. Walter Seaver, U. S. Steel Products Co, S. F.

Mr and Mrs. Garnett Young, Tel. Electric Equip. Co., S. F.
T. E. Bibbins, General Electric Co., San Francisco.
H. V. Carter, Pacific States Electric Co., San Francisco.
C. H. Carter, Pacific States Electric Co., Los Angeles.
H. H. Cudmore, Mazda Bureau, San Francisco.
W. R. Dunbar, Westinghouse Elec. & Mfg. Co., San Francisco.
R. J. Davis, Century Electric Co., San Francisco.
F. D. Fagan, General Electric Co., San Francisco.
S. W. Gilman, John A. Roebling's Sons Co., San Francisco.
Cass Gilson, Gilson Electric Co., Oakland.
S. B. Gregory, Arrow Electric Co., San Francisco.
W. L. Goodwin, Pacific States Electric Co., San Francisco.
C. B. Hall Illinois Electric Co., Los Angeles.
W. Brewster Hall, Pass & Seymour, San Francisco.
A. H. Halloran, Journal of Electricity, Power and Gas, S. F.
Ross Hartley, Pacific States Electric Co., Portland.
B. A. Hansen, A. G. Electric Co., San Francisco.
Geo. Holberton, Pacific Gas & Electric Co., San Francisco.
C. R. Hunt, Robbins & Myer Co., San Francisco.
W. H. McLaren, General Electric Co., San Francisco.
S. M. Kennedy, So. California Edison Co., Los Angeles.
J. M. Morris, Westinghouse Elec. & Mfg. Co., Los Angeles.
C. M. Parr, The H. & H. Mfg. Co., Hartford, Conn.
D. L. Reynolds, Holabird-Reynolds Electric Co., Los Angeles.
H. E. Sanderson, Bryant Electric Co., San Francisco.
Miles Steel, Benjamin Electric Co., San Francisco.
Sam'l Taylor, Electric Ry. & Mfrs. Supply Co., San Francisco.
J. A. Vandegrift, Oakland Lamp Works, Oakland.
C. E. Wiggin, Dunham, Carrigan & Hayden Co., San Francisco.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Santa Maria Gas and Power Company, operating in Santa Barbara and San Luis Obispo counties, has filed an application with the commission requesting authority to issue $25,000 par value of 6 per cent bonds.

The commission has issued an order authorizing the Southwestern Home Telephone Company to renew promissory notes totaling $11,000. These notes are to be secured by a pledge of $22,000 of the telephone company's bonds.

The commission has issued an order authorizing the Central California Traction Company to lease its lines in the city of Stockton to the Stockton Electric Railroad Company for the sum of $12,500 per annum for the first three years and $15,000 per annum for the remaining period of the lease, which is to run from January 1, 1915, to January 1, 1953.

The commission has authorized the Southern Sierras Power Company to issue $300,000 of its first mortgage 6 per cent twenty-five year bonds.

The commission has issued an order authorizing the Long Beach Consolidated Gas Company to issue $100,000 of first mortgage 6 per cent bonds at not less than 95.

Andrew Sorensen, of Oakland, has filed an application with the commission requesting authority to sell the public utility property owned by him to the East Oakland Water and Electric Company. The electric company asks for authority to issue $20,000 par value of stock, to be used in acquiring the property, and to furnish funds for the improvement of its plant and distributing system.

The commission has issued an order at the request of the Union Home Telephone and Telegraph Corporation dismissing its application for authority to issue a sufficient number of treasury bonds to pay for the placing of its aerial wires underground, in compliance with the ordinance requirements of the cities of San Bernardino and Long Beach.

The Loyalton Electric Light Company has filed an application with the commission requesting authority to discontinue its electric system in the city of Loyalton, Sierra county. The application states that the company has been conducting its business at a loss for the past seven years and that as the population of Loyalton has been diminished by more than half there is no hope of ever conducting the business at a profit.

NEW CATALOGUE

Circular No. 37 from the U. S. Bureau of Standards entitled "Electric Wire and Cable Terminology" gives standard definitions and explanations of terms concerning electric wires and cables.

MUNICIPAL OWNERSHIP AT SEATTLE.

A number of articles have been appearing in the daily papers of the Pacific Northwest and elsewhere regarding municipal ownership conditions at Seattle. As they evidently reflect the opinion of many people they should be given further publicity.

A Municipal Ownership Problem.

A frog in a bottomless well climbs up eleven feet and falls back eighteen feet per day—when will it get out of the well?

That Mayor Gill's recent veto of a Seattle City Council bill to transfer the municipal railway substations to the Lighting Department was justified is clearly evident when the financial effect of such transfer is studied.

During the period between May 23, 1914—the date Division "A" was started—and March 1, 1915, the Lighting Department furnished the municipal railways 1,113,491 kilowatt hours alternating current at an efficiency of approximately 59 per cent, resulting in 649,550 kilowatt hours direct current being supplied to operate the railways. By ordinance the City Council fixed a rate of 1¼ cents per kilowatt hour for this current, so that the Lighting Department would derive a total revenue from this service for the nine months of operation of $8119.38.

The municipal railway constructed two substations at a cost of $60,515.85 for land, buildings and equipment. The Lighting Department supplied alterating current to these substations. A dispute arose between the Superintendent of the Lighting Department and the Superintendent of the Municipal Railways as to the charge to be made for the current supplied. No payments were made for current for eight months, when the City Council passed an ordinance fixing a rate of 1¼ cents per kilowatt hour for direct current and later passed another ordinance transferring the substations to and placing their operation under the Lighting Department. This last ordinance has been vetoed by the Mayor, but it is said will be passed over his veto. The Council further directed that the Lighting Department pay for the substations by current furnished to the railways at 1¼ cents per kilowatt hour and that all past bills be liquidated in that manner, and future charges likewise, until the cost of the substations would be absorbed. The net result of this arrangement is as follows:

Expenses for substation operation and supplies to March 1, 1915, approximately 9 months	$ 5,500.00
Depreciation at 4 per cent on $60,515.85 (cost of substations) for same period	4,453.96
Interest on $60,515.85 (cost of substations) at 5 per cent, for same period	2,269.35
Cost of producing 1,113,491 kw.-hr. at 4 mills*	4,453.96
Total cost for 649,550 kw.-hr. direct current to the lighting department for the same period	14,038.79
Amount to be paid by the railway to the lighting department for 649,550 kw.-hr. at 1¼c per kw-hr.	8,119.38
Loss to lighting department for 9 months	$ 5,919.41

*In a communication to the mayor, under date of December 14, 1914, the superintendent of lighting made this statement: "The lighting department can offer for 1915 a minimum rate of ¾c per kw.-hr. for alternating current for motor generators. This figure is based on actual cost to the lighting department and includes no operating expense or fixed charges on railway substations and equipment. This rate will also apply to Divisions "A" and "C" of the municipal railways."

Reducing these figures to an annual basis, the Lighting Department would receive from the railways for power furnished $10,815.82, which cost the Lighting Department to produce $18,718.36, showing an annual loss suffered by the Lighting Department of $7,902.54.

When will the Lighting Department have earned from the sale of current to the municipal railways the $60,515.85 which it is to pay for the railway substations?

The Everett (Wash.) Spectator of March 12 contained the following editorial:

"Investigation which has just been made shows the port commission of Seattle has spent $5,000,000 and has nothing

much to show for it in the way of practicable shipping facilities. The expectation was that a comprehensive system of wharfs would be planned to make the city water front one that would attract a great volume of shipping because of the ease and cheapness with which cargo could be handled. But in checking up the people find they have nothing but a number of scattered wharfs and warehouses not so accessible as those under private ownership. It is a curious thing that most municipal ownership enterprises stand as impressive illustrations of how not to do it. It seems impossible to keep politics out of the operation, and political intervention invariably means waste and generally means graft as well. Seattle has now called a halt in her port development project, but the horse has been stolen. And right now a noisy municipal-ownership minority is demanding an expansion of the municipal street railway lines that have shown a big deficit in every month of their operation. Stopping of the dock-building project does not make it certain that it will be done better, but only that it will be done differently when it shall be resumed."

The following is from an editorial in the Portland Oregonian of March 4:

"Seattle has gone into the public lighting and power business upon the urge of the municipal ownership cult and is accumulating large annual losses.

"Seattle has a municipal street railway line which gives neither service nor profit, and which is utterly orphaned as to its relations to the city's general transportation organization.

"Seattle has spent $4,000,000 or $5,000,000 in public docks, which are now losing $300,000 per annum, and it is being importuned to invest millions more.

"Seattle has the highest tax levy of any city on the Pacific Coast. It has undertaken more unpromising and unprofitable public enterprises than any other city. It has a greater debt per capita than any other place. Its method of paying old debts is to contract new ones.

"Before Portland is frightened into emulation of Seattle in too many matters requiring the expenditure of much money, it will be well to wait and see whether Seattle is wise in mortgaging the future for the sake of an unrealizable present."

PRICE REDUCTIONS IN EDISON MAZDA LAMPS.

Practically all the sizes and types of Edison Mazda multiple lamps are affected by reductions in list prices that were put into effect April 1, 1915, by the Edison Lamp Works of General Electric Company. On the regular straight side and round bulb lamps, from the 10-watt to the 250-watt sizes, also on sign lamps, stereopticon lamps, etc., the reductions range from 3 to 20 cents per lamp, according to the size. These reductions, which average about 10 per cent, will tend to popularize further already popular lamps.

The new concentrated filament vacuum lamps of 25, 40 and 60 watt sizes now list at only 5 cents per lamp more than the regular lamps of corresponding sizes.

On the gas-filled, multiple lamp of 100 to 1000 watt sizes, the reductions range from 50 cents to $1 per lamp, the average reductions being between 20 and 25 per cent. The introduction of gas-filled lamps has been exceptionally rapid. Over a million are already in use. The decreased cost of these lamps will undoubtedly result in a still more rapid replacement of vacuum lamps by the more efficient gas-filled units.

POWER PLANT AT RIVERSIDE BURNS.

Fire on March 28 destroyed the oldest commercial electrical plant in California. This was located between Riverside and Highgrove and was owned and operated by the Pacific Electric Light and Power corporation of Los Angeles. An explosion of a transformer caused the fire, which, because of the inflammable condition of the building, caused the plant to quickly become a charred wreck. G. S. Garner, the superintendent, had a close call from being caught in the burning building.

The plant was built in 1887 and for a number of years supplied electricity to San Bernardino, Colton, Riverside and Redlands. Power was generated by a forty-foot fall of water from the upper canal of the Riverside Water Company. Superintendent Garner had been in charge of the plant for eleven years. Trolley service in Riverside was interrupted a couple of hours because of the fire and Highgrove was without lights until late in the evening, when connection was made with another of the company's plants. The loss was between $15,000 and $20,000.

TRADE NOTES.

E. H. Bellinger is installing the electrical equipment for the Ingersoll Construction Company, Portland.

Kingery & Marrs also are furnishing the electrical fixtures for Schwain & Company, 111 Fourth street, Portland.

J. C. English & Company are furnishing the electrical fixtures for the new dining room in the Imperial Hotel, Portland.

The Pacific Coast Electric Company has the electric contract for the apartment house being built at 333 Third street, Portland.

The electric wiring contract for the Municipal Dock No. 2, Portland, has been awarded to Miller Halls of Portland, Oregon, for $2512.

The Morrison Electric Company has opened a splendidly equipped retail store at 111 West Park street, in the Pittock Building, Portland.

Kingery & Marrs are furnishing the electrical fixtures for the four story hotel on the northeast corner Fourth and Alder streets, Portland.

The Keystone Iron Co. of Los Angeles was awarded the contract for ornamental street lights at Pomona, Cal. The price was $15,938 and the contract covers 200 electroliers.

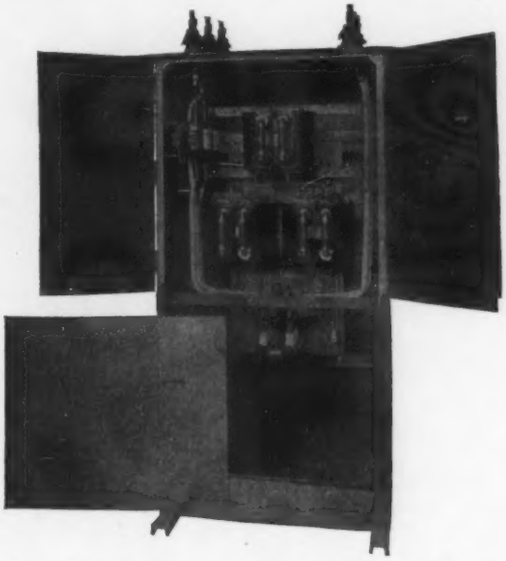
Announcement will shortly be made by the Holophane Works of General Electric Company of the appointment of the Pacific State Electric Company as sole distributing agent for the former company's products on the entire Pacific slope. The arrangement provides for an adequate stock of Holophane products being carried by the latter company, thus assuring practically immediate deliveries to western customers, thereby improving the service and avoiding delays heretofore arising on account of the goods having to be shipped direct from the factory. The agency quarters and sample rooms maintained by the Holophane Works have been transferred to the Pacific States Electric Company Building, San Francisco. Mr. Hal Lauritzen, who for many years has conducted the business of the Holophane Works on the Pacific Coast will continue to conduct the sales of the products of the Holophane Works.

Electrical dealers are manifesting great interest in the prize fan window contest which is being conducted by the Western Electric Company. One dealer is preparing a miniature Atlantic City board-walk to run along the front of the window, upon which will move an endless belt carrying miniature dolls, roller chairs, settees, etc. Another enterprising dealer is rigging up a lighthouse on the rocks, using a winker socket to give the resemblance of a flashing light. Still another has made an endless belt arrangement to which he intends to attach small lifeboats that will go bouncing along back of the wave cut-out. The window display outfit, which the Western Electric Company furnishes free, lends itself admirably to any of these and many other schemes, and there is no doubt that when the contest closes on September 1st and the awards made, which are to be based on their probable ability to attract genuine interest to electric fans, the six prize winning windows will reveal other and more attractive displays.

INDUSTRIAL

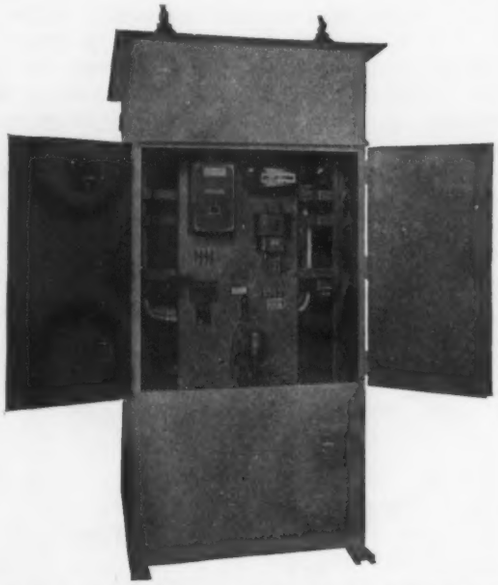
RURAL SUBSTATION IN RAILWAY SIGNAL WORK.

The field of application of the rural substation is constantly broadening as its merits become better recognized. The main features are, of course, mobility, ease of installation and low initial cost when compared with a permanent indoor substation of like capacity to accomplish the same



Front View of 4400-Volt, Three Phase, Switch House for Railway Signal Work.

result. These points often exert a weighty influence on the solution of the problem of electricity supply, especially when the problem of revenue is somewhat speculative, or the need for power either temporary or seasonal. In other cases the



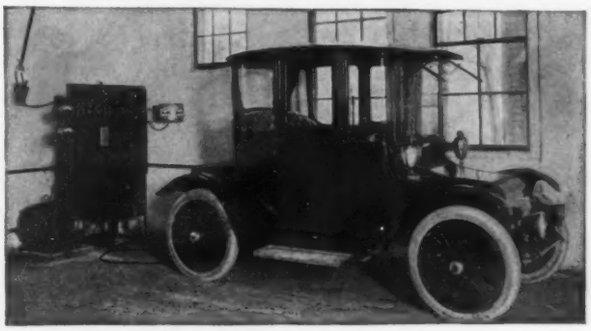
Rear View of 4400-Volt, Three Phase Switch House for Railway Signal Service.

question of the cost does not determine the installation itself, but merely its character. The accompanying illustrations show views of the first outdoor type steel switch houses of this class built for railway signal purposes, and are used in this connection by the Southern Railway at Inman, S. C., and Austell, Ga. The outdoor substations, of which the switch houses are a part, effect a considerable saving in outlay when compared with what would have been the cost of a substantial permanent substation to house the equipment. Each house is located at the foot of a pole tower supporting the transmission line, the outdoor power transformers, disconnecting switches, choke coils and lightning arresters.

The equipment of the switch houses is a little more elaborate than usually required for power or lighting purposes. The ordinary house, such as exhibited at the Railway Appliance Association Exhibition last month, has merely an oil switch, or an oil switch and watthour meter, with the necessary current and potential transformers. In the house illustrated, there are also an extra potential transformer, a voltmeter, a circuit closing relay, two potential receptacles, and an incandescent lamp with bracket. The extra transformer, two potential receptacles and voltmeter in connection with the other two potential transformers required for the watthour meter, allow the voltage to be read on both sides of the oil switch before it is closed. The incandescent lamp gives illumination at night for reading the voltage or for lighting the inside of the house. The circuit closing relay is used in the usual manner to trip the oil switch in case of overload or short circuit.

GARAGE CHARGING EQUIPMENT.

The accompanying illustration shows the corner of the Corey Hill Garage, Brookline, Mass., in which the battery-charging equipment is located. The service supplied this garage is single-phase A. C., a Wagner rotary converter being used to furnish the direct current for charging. The leads to the charging outlets are carried in conduit shown running parallel



Corey Hill Garage.

with the floor and about three feet above it. The panel to the right carries four unit type charging rheostats, with a space below for mounting two more. This type of rheostat is made by the Cutler-Hammer Mfg. Co., of Milwaukee. The charging is easily cared for; no technical experience is necessary and no rod needed to manipulate the rheostats. The rheostat handles are within easy reach, conveniently arranged for charging one or two, three or four electrics at the same time from the one location. Automatic protection against overcharge, against charging back into the line, etc., are easily attained. An instrument switch on each panel permits reading the voltage of any battery on charge. The rheostat units and panels are furnished completely wired, the service and battery leads only need be secured to lugs located accessibly for the purpose. As greater charging capacity is needed more units can be easily added.

NEWS NOTES

FINANCIAL.

PORTLAND, ORE.—During 1914 the Portland Gas & Coke Company collected $1,212,693.97 for the sale of gas, according to the annual statement filed with City Treasurer Adams. This action is in compliance with the law passed by the voters several years ago providing for a special tax of 3 per cent of the gross receipts of all public service corporations. The statement is filed under protest, a letter accompanying the statement saying that the company waives none of its rights in this case now before the Supreme Court involving the legality of the measure. Should the law be held valid the city's share of the gas company's receipts for the year would be $36,380.

NORTH YAKIMA, WASH.—The assets of the Hanford Irrigation & Power Company of an estimated value of over $1,000,000 have been sold by Receiver E. F. Benson to Henry K. T. Lyons of Denver, for $386,000. Of this sum $213,733 is paid in cash, the balance in bonds of the company at face value and accrued interest. The buyer is represented by John J. Blake of Boise, Idaho. Other bidders say the purchase is in the interest of the American Light & Power Company, one of the judgment creditors. The greatest asset of the company is the water power of Priest Rapids on the Columbia River, while lands near which have been purchased by parties believed to represent the American Light & Power Company.

ILLUMINATION.

WALLACE, IDAHO.—John H. Woums and associates have filed a petition for a franchise for a gas plant.

POST CITY, TEXAS.—The Post Power Company is ready to install the lighting system and work will soon begin.

OREGON, CITY, ORE.—Work will soon be begun on the construction of gas mains by the Portland Gas & Coke Company.

LOS ANGELES, CAL.—The board of supervisors has adopted a resolution establishing the Homeward avenue lighting district.

SEATTLE, WASH.—The electric franchise granted to the Vashon Electric Company has been cancelled by reason of non-compliance.

HONOLULU, T. H.—A resolution providing for the appropriation of $34,000 for electric light plant and police signal system has been adopted.

SAN JACINTO, CAL.—A new lighting proposition has been presented to the board of trustees by Manager P. L. Nourse of the power company.

TEKOA, WASH.—The Council has awarded a contract for street lighting to the Idaho-Washington Light & Power Company, which calls for fifteen new lights.

SAN GABRIEL, CAL.—The board of trustees has awarded a contract for electric lights on a portion of Mission Drive to the D. S. McEwan Electric Company at $2380.

DEER LODGE, MONT.—The council has voted to advertise for bids for the construction of a system of cluster lights for the business section. The estimated cost is $6000.

HOLTVILLE, CAL.—City Manager Starbuck has been instructed by the board of trustees to prepare plans for a lighting system and to start proceedings for the improvement at once.

PORT ANGELES, WASH.—Bids will be received until April 20th by the city for the purchase of the second-hand lighting plant on Cherry street between First and Second avenues.

POMONA, CAL.—The city council has awarded the contract for an ornamental lighting system for the business district to the Keystone Iron Works at $15,938.80. Work will begin immediately.

FILLMORE, CAL.—Stanley Lotheridge, manager of the Santa Paula branch of the Ventura County Power Company, has presented the matter of additional lights and improvements to the lighting system, to the board of trustees.

LOS ANGELES, CAL.—The board of supervisors will receive sealed bids up to April 12 for installing and maintaining an addition to the system of street lighting in Bairdstown Lighting District, in accordance with plans on file with the board.

ELLENSBURG, WASH.—Bids will be received until April 5th by Reuben Crimp, city Clerk, for the construction of a power plant building, including concrete work, spillways, steam turbine, condenser, water pump, boiler, water wheel governor, wiring, etc.

LOS ANGELES, CAL.—An ordinance of intention has been adopted by the council to order ornamental lighting posts and appliances in Victoria Park, to be maintained and electric current furnished for a period of one year beginning July 1, 1915, and ending June 30, 1916.

STOCKTON, CAL.—Owing to the increase of business a new 1500 kilowatt water driven generator unit will be installed in the hydroelectric plant of the Western States Gas & Electric Company, Stockton, California Division on the American River, and an additional boiler will be erected in Steam Station "B."

LOS ANGELES, CAL.—An ordinance of intention has been adopted by the council for the installation of ornamental lighting posts on Hollywood Boulevard, between Cherokee and Orchid avenues, to be maintained and electric current furnished for a period of one year beginning July 1, 1915, and ending June 30, 1916.

LOS ANGELES, CAL.—The board of supervisors has awarded the contract for improvement work in the Miramonte and Florence Lighting Districts to the Southern California Edison Company, and the contract for furnishing current to the Los Angeles Gas & Electric Company. The contract for lighting current in Hawthorne district was awarded to the Southern California Edison Company.

ELLENSBURG, WASH.—Plans and specifications for the improvements at the municipal light plant were submitted to the council by Engineer Carter and the clerk was instructed to issue a call for bids. The improvements include a modern fireproof building to house the light plant and a new steam auxiliary turbine capable of carrying the entire load in emergency. The expense is estimated at $55,000.

TRANSMISSION.

GALLUP, N. M.—The American Fuel Company is installing a transmission line from the Gibson electric plant to Gallup.

RIVERSIDE, WASH.—The Okanogan Valley Power Company has made application for a franchise upon the public highways of Okanogan county. A hearing is set for April 8th.

PRESCOTT, ARIZ.—The Humboldt Consolidated Company is making preparations to install electrical machinery at the De Soto mine, which will be capable of furnishing 150 h.p.

FRESNO, CAL.—The trustees have authorized the ordinance committee to draw up an ordinance requiring all power, telephone and telegraph wires to be placed underground within a certain period of years.

TRANSPORTATION.

MONTESANO, WASH.—The board of county commissioners set April 5th as the date for hearing on the franchise asked by N. W. Electric & Water Works.

KALISPELL, MONTANA.—At an election to be held April 5 the question of granting an interurban franchise to the Flathead Development Company will be submitted to a vote.

FRESNO, CAL.—A franchise for a term of 25 years to construct and maintain a street railroad over portions of streets in Fresno, has been granted the Fresno Interurban Railway Company.

REDWOOD CITY, CAL.—An ordinance approving the transfer of the street railway franchise on Chestnut street from Judge E. E. Fitzpatrick to the Redwood City Harbor Commission, has been adopted.

THE DALLES, ORE.—Promoters are in the field making investigation regarding the construction of an electric line up Mill Creek to tap the timber belt and to conduct a general freight and passenger business. Surveys have been made up both Chenowith and Mill Creeks, but it is said that the Mill Creek route is favored.

STOCKTON, CAL.—The Central California Traction Company has arranged to lease its lines in this city to the Stockton Electric Railroad Company for the sum of $12,500 per annum for the first three years, and $15,000 per annum for the remaining period of the lease, which is to run from January 1, 1915, to January 1, 1953.

TELEPHONE AND TELEGRAPH.

DEMING, N. M.—James Johnston has the contract to remove the old telephone line. A new and up-to-date line will be put in.

WALLA WALLA, WASH.—E. E. Moots was awarded the contract for the construction of the trunk telephone line from Dixie to Walla Walla, at $2070.

MEDFORD, ORE.—Will G. Steel, superintendent of the Crater Lake National Park, has been authorized to construct a phone line to Crater Lake from Prospect.

EUGENE, ORE.—The Lane County Court has granted a franchise to E. J. Horton, S. M. Horton and J. C. Horton to build a telephone line along the county roads.

HARRINGTON, WASH.—An ordinance passed the council granting to the Farm and City Telephone Company a franchise for poles, wires, etc., for a telephone line in the city.

VANCOUVER, B. C.—Another telephone cable is being proposed by the B. C. Telephone Company across Burrard inlet, connecting the lumber mill at Roche Point with Barnet. The cable will be 7000 ft. long. Rock Creek, a few miles from Midway, will have an exchange.

WATERWORKS.

EUGENE, ORE.—The city of Florence at the mouth of the Siuslaw River will hold a special election on June 7th, to vote on the sale of bonds for a $100,000 water plant.

SPOKANE, WASH. The voters at a recent election sanctioned the purchase of the Raymond water system and voted to bond the city for $117,500 for the purchase and for making extensions.

BATTLE MOUNTAIN, NEV.—H. C. Christensen, H. R. Lemaire and St. Claire Moore have applied for a 25 year franchise to construct an electric light, power and water plant in this city.

HONOLULU, T. H.—The supervisors have appropriated $19,000 for the purchase and installation of a 3,000,000 gallon pump which will assure an ample water supply in Kaimuki and Waikiki for 30 years.

BAKER CITY, ORE.—The town of North Powder will hold a special election April 19th to adopt a new charter which will vest in the city council the right to issue bonds in the sum of $20,000 for the construction of a municipal water system.

AMITY, ORE.—An ordinance has been passed authorizing the construction of a water system and the issuance and sale of negotiable bonds of the city in the sum of $15,000, to pay for the same. The work will be started as soon as funds are available.

LOS ANGELES, CAL.—Chief Engineer Mulholland, Special Counsel Mathews and City Attorney Stephens have been named a committee to prepare plans for serving thousands of consumers in the outlying districts of the city with water from the municipal waterworks system.

LOS ANGELES, CAL.—The board of public service commissioners has awarded contracts for water meters as follows: Neptune Meter Company, 4580 meters; Thompson Meter Company, 1620 meters; Gama Meter Company, 100 meters, and Hersen Meter Manufacturing Company 100 meters. The total awards amount to about $60,000.

POCATELLO, IDAHO.—A contract has been drawn up by the city and J. A. Jones, owner of the water system, which provides that if Mr. Jones develops 6 second feet of water by the 15th of next July, that the water with all rights will be purchased for $60,000. Unless the terms of the contract are fulfilled, the city will be under no obligations to purchase the water system.

DALLAS, ORE.—The council has instructed the auditor to discontinue further proceedings toward the purchase of the water plant and has authorized the city attorney to draft an ordinance repealing the ordinance which provided for submitting the question to the people. This action was taken because public sentiment is against buying the water plant and to save the expenses of an election.

PORTLAND, ORE.—The Pacific Tank & Pipe Company has been awarded the contract by authority of the Secretary of the Interior for furnishing 5520 ft. of machine banded wood pipe on its bid of $2633 to the Sunnyside unit, Yakima project, Washington. This company also secured the contract for furnishing 4800 ft. of 46 in. pipe for the Outlook Irrigation District, Sunnyside unit, at $11,345.

SACRAMENTO, CAL.—Plans and specifications for the new water main system have been accepted by the city commission. Bids will be called for immediately and opened April 20th. Engineers Hyde and Wilhelm, estimate the cost of the system at from $800,000 to $850,000. A 36 inch pipe will be installed in place of two 40 inch pipes, as provided in the original plan. The high pressure system in the business section is eliminated as unnecessary at present. The engineers claim the city is adequately provided under their plans for at least 20 years.

BILLINGS, MONT.—Four contracts for the improvement and extensions to the municipal water system have been awarded by the city council aggregating $143,624.80. The contracts are as follows: Six concrete settling basins, 6,000,000 gallons daily capacity, cast iron pipes, Hanlon & Oakes, Sioux City, Iowa, $71,790; entire water works extensions, including six miles of cast iron pipe, Gordon, Taylor Company of Denver, at $34,709.80; filter equipment, including sand beds and machinery, Pittsburg Filter Manufacturing Company of Pittsburg, Penn., at $35,175; pump and motor, Hanlon & Oakes, $1950.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page opposite

A-1 **American Ever-Ready Works of National Carbon Co.**...
Los Angeles; 755 Folsom Street, San Francisco; Seattle.

B-2 **Benjamin Electric Manufacturing Co.**...
Rialto Bldg., San Francisco.

B-3 **Blake Signal and Manufacturing Co.**...
680 Howard Street, San Francisco.

B-5 **Bridgeport Brass Co.**... 3
(See Pierson, Roeding & Co.)

B-6 **Berkeley Electric Cooker Co.**...
1932 Center Street, Berkeley.

B 7 **Busch-Sulzer Bros.-Diesel Engine Co.**...
Rialto Bldg., San Francisco.

C-1 **Century Electric Co.**...14
614 South Grand Avenue, Los Angeles; 56 Natoma Street, San Francisco; Seattle; Spokane.

C-3 **Crocker-Wheeler Co.**...
Salt Lake City; First National Bank Bldg., San Francisco; Seattle.

C-4 **Cutler-Hammer Manufacturing Co.**...
579 Howard Street, San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-1 **D. & W. Fuse Co.**...
Western Electric Co.

D-2 **Dearborn Drug and Chemical Works.**... 4
355 East Second Street, Los Angeles; 301 Front Street, San Francisco.

E-1 **Edison Lamp Works of General Electric Co.**...
Rialto Bldg., San Francisco.

E-2 **Edison Storage Battery Supply Co.**... 4
441 Golden Gate Avenue, San Francisco.

E-3 **Electric Agencies Co.**...
247 Minna Street, San Francisco; Central Building, Los Angeles.

E-4 **Electric Storage Battery Co.**... 3
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; 118 New Montgomery Street, San Francisco; Colman Bldg., Seattle.

F-1 **Fairbanks, Morse & Co.**...
Los Angeles; Portland; 651 Mission Street, San Francisco; Seattle; Spokane.

F-2 **Fort Wayne Electric Works of G. E. Co.**...
Rialto Bldg., San Francisco; Colman Bldg., Seattle.

G-1 **General Electric Co.**...10-11-12
124 W. Fourth Street, Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

H-1 **Habirshaw Wire Co.**...
(See Western Electric Company.)

H-2 **Hemingray Glass Co.**... 4
330 So. L. A. Street, Los Angeles; 345 Oak Street, Portland; 807 Mission Street, San Francisco.

H-5 **Hunt, Mirk & Co.**...
141 Second Street, San Francisco.

H-6 **Hubbard & Co.**...
Rialto Bldg., San Francisco.

I-1 **Indiana Rubber and Insulated Wire Co.**...
Fobes Supply Co., Portland and Seattle.

K-1 **Kellogg Switchboard and Supply Co.**...
Aronson Bldg., San Francisco.

K-4 **K-P-F Electric Co.**...
37 Stevenson Street, San Francisco.

L-1 **Leahy Manufacturing Co.**...
Eighth and Alameda Street, Los Angeles.

L-2 **Locke Insulator Manufacturing Co.**... 3
(See Pierson, Roeding & Co.)

M-2 **McGlauflin Manufacturing Co.**...
Sunnyvale, Cal.

M-4 **Morse Chain Co.**... 6
Monadnock Bldg., San Francisco.

M-3 **Moore & Co., Charles C.**... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 **Nason & Co., R. N.**...
151 Potrero Avenue, San Francisco.

N-2 **National Conduit & Cable Co., The.**...
Trust and Savings Bldg., Los Angeels; Rialto Bldg., San Francisco.

N-3 **National Lamp Works of G. E. Co.**...
(All Jobbers.)

N-4 **New York Insulated Wire Co.**... 4
629 Howard Street, San Francisco.

O-1 **Okonite Co. (The)** ...14
(All Jobbers.)

P-1 **Pacific Electric Manufacturing Co.**...
80 Tehama Street, San Francisco.

P-2 **Pacific States Electric Co.**... 2
236-240 So. L. A. Street, Los Angeles; 90 Seventh Street, Portland; 200-210 12th Street, Oakland; 575 Mission Street, San Francisco; 307 First Avenue, So., Seattle.

P-4 **Pelton Water Wheel Co.**... 4
2219 Harrison Street, San Francisco.

P-5 **Pierson, Roeding & Co.**... 3
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 **Pittsburgh Piping & Equipment Co.**...14
Monadnock Bldg., San Francisco.

S-1 **Schaw-Batcher Company, Pipe Works, The.**... 4
211 J Street, Sacramento; 356 Market Street, San Francisco.

S-3 **Simplex Electric Heating Co.**...14
612 Howard Street, San Francisco.

S-4 **Southern Pacific Co.**... 2
Flood Bldg., San Francisco.

S-5 **Sprague Electric Works.**...14
Rialto Bldg, San Francisco; Colman Bldg.; Seattle; 124 West 4th Street, Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 **Standard Underground Cable Co.**... 2
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 **Thomas & Co., R.**...
(See Western Electric Co.)

W-1 **Wagner Electric Manufacturing Co.**... 3
Rialto Bldg., San Francisco.

W-2 **Western Electric Co.**...
8th and Santee Streets, Los Angeles; 507 Sixteenth Street, Oakland; 680 Folsom Street, San Francisco; 907 First Avenue, Seattle; 45 North Fifth Street, Portland, Ore.

W-4 **Westinghouse Electric and Manufacturing Co.**...
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second Street, San Francisco; Second and Cherry Streets, Seattle; Paulsen Bldg., Spokane.

W-5 **Westinghouse Machine Co.**...
141 Second Street, San Francisco.

W-6 **Westinghouse Lamp Co.**...
(See Westinghouse Electric and Manufacturing Co.)

W-8 **Western Pipe & Steel Co.**...
444 Market Street, San Francisco; 1758 North Broadway, Los Angeles.